

**UNITED STATES DISTRICT COURT  
FOR THE WESTERN DISTRICT OF TEXAS  
WACO DIVISION**

XR COMMUNICATIONS, LLC, dba  
VIVATO TECHNOLOGIES,

Plaintiff,

v.

CISCO SYSTEMS, INC.  
MERAKE LLC

Defendants.

Case No. 6:21-cv-623

**JURY TRIAL DEMANDED**

**COMPLAINT FOR PATENT INFRINGEMENT AGAINST  
CISCO SYSTEMS, INC. AND MERAKE LLC**

This is an action for patent infringement arising under the Patent Laws of the United States of America, 35 U.S.C. § 1 *et seq.*, in which Plaintiff XR Communications LLC d/b/a Vivato Technologies (“Plaintiff” or “Vivato”) makes the following allegations against Defendant Cisco Systems, Inc. and Meraki LLC (“Defendants”):

**INTRODUCTION**

1. This complaint arises from Defendants’ unlawful infringement of the following United States patents owned by Vivato, each of which generally relate to wireless communications technology: United States Patent Nos. 7,729,728 (the “’728 Patent”), 10,594,376 (the “’376 Patent”), 8,289,939 (the “’939 Patent”) (collectively, the “Asserted Patents”).

2. Countless electronic devices today connect to the Internet wirelessly. Beyond just connecting our devices together, wireless networks have become an inseparable part of our lives in our homes, our offices, and our neighborhood coffee shops. In even our most crowded spaces, today’s wireless technology allows all of us to communicate with each other, on our own devices,

at virtually the same time. Our connected world would be unrecognizable without the ubiquity of sophisticated wireless networking technology.

3. Just a few decades ago, wireless technology of this kind could only be found in science fiction. The underlying science behind wireless communications can be traced back to the development of “wireless telegraphy” in the nineteenth century. Guglielmo Marconi is credited with developing the first practical radio, and in 1896, Guglielmo Marconi was awarded British patent 12039, *Improvements in transmitting electrical impulses and signals and in apparatus there-for*, the first patent to issue for a Herzian wave-based wireless telegraphic system. Marconi would go on to win the Nobel Prize in Physics in 1909 for his contributions to the field.

4. One of Marconi’s preeminent contemporaries was Dr. Karl Ferdinand Braun, who shared the 1909 Nobel Prize in Physics with Marconi. In his Nobel lecture dated December 11, 1909, Braun explained that he was inspired to work on wireless technology by Marconi’s own experiments. Braun had observed that the signal strength in Marconi’s radio was limited beyond a certain distance, and wondered why increasing the voltage on Marconi’s radio did not result in a stronger transmission at greater distances. Braun thus dedicated himself to developing wireless devices with a stronger, more effective transmission capability.

5. In 1905, Braun invented the first phased array antenna. This phased array antenna featured three antennas carefully positioned relative to one another with a specific phase relationship so that the radio waves output from each antenna could add together to increase radiation in a desired direction. This design allowed Braun’s phased array antenna to transmit a directed signal.

6. Building on the fundamental breakthrough that radio transmissions can be *directed* according to a specific radiation pattern through the use of a phased array antenna, directed

wireless communication technology has developed many applications over the years. Braun's invention of the phased array antenna led to the development of radar, smart antennas, and, eventually, to a technology known as "MIMO," or "multiple-input, multiple-output," which would ultimately allow a single radio channel to receive and transmit multiple data signals simultaneously. Along the way, engineers have worked tirelessly to overcome limitations and roadblocks directed wireless communication technology.

7. At the beginning of the twenty-first century, the vast majority of wireless networks still did not yet take advantage of directed wireless communications. Instead, "omnidirectional" access points were ubiquitous. Omnidirectional access points transmit radio waves uniformly around the access point in every direction and do not steer the signal in particular directions. Omnidirectional antennas access points do typically achieve 360 degrees of coverage around the access point, but with a reduced coverage distance. Omnidirectional access points also lack sophisticated approaches to overcome certain types of interference in the environment. As only one example, the presence of solid obstructions, such as a concrete wall, ceiling, or pillar, can limit signal penetration. As another example, interference arises when radio waves are reflected, refracted, or diffracted based on obstacles present between the transmitter and receiver. The multiple paths that radio waves can travel between the transmitter and receiver often result in signal interference that decreases performance, and omnidirectional access points lack advanced solutions to overcome these "multipath" effects.

8. Moving from omnidirectional networks to modern networks has required an additional series of advancements that harness the capabilities of directed wireless technology. These advancements range from conceiving various ways to steer and modify radiation patterns, to enhancing the transmission signal power in a desired direction, to suppressing radiation in

undesired directions, to minimizing signal “noise,” and then applying these new approaches into communications networks with multiple, heterogenous transmitters and receivers.

9. Harnessing the capabilities of directed wireless technology resulted in a significant leap forward in the signal strength, reliability, concurrent users, and/or data transmission capability of a wireless network. One of the fundamental building blocks of this latest transition was the development of improvements to MIMO and “beamforming,” which are the subject matter of patents in this infringement action. The patents in this action resulted from the investment of tens of millions of dollars and years of tireless effort by a group of engineers who built a technology company slightly ahead of its time. Their patented innovations laid the groundwork for today’s networks, and are infringed by Defendants’ accused products.

## **PARTIES**

10. Plaintiff XR Communications, LLC, d/b/a Vivato Technologies (“Vivato” or “Plaintiff”) is a limited liability company organized and existing under the laws of the State of Delaware with its principal place of business at 2809 Ocean Front Walk, Venice, California 90291. Vivato is the sole owner by assignment of all right, title, and interest in each Asserted Patent.

11. Vivato was founded in 2000 as a \$80+ million venture-backed company with several key innovators in the wireless communication field including Siavash Alamouti, Ken Biba, William Crilly, James Brennan, Edward Casas, and Vahid Tarokh, among many others. At that time, and as remains the case today, “Wi-Fi” or “802.11” had become the ubiquitous means of wireless connection to the Internet, integrated into hundreds of millions of mobile devices globally. Vivato was founded to leverage its talent to generate intellectual property and deliver Wi-Fi/802.11 wireless connectivity solutions to service the growing demand for bandwidth.

12. Vivato has accomplished significant innovations in the field of wireless communications technology. One area of focus at Vivato was the development of advanced wireless systems with sophisticated antenna designs to improve wireless speed, coverage, and reliability. Vivato also focused on designing wireless systems that maximize the efficient use of spectrum and wireless resources for large numbers of connected mobile devices.

13. Among many fundamental breakthroughs achieved by Vivato are inventions that allow for intelligent and adaptive beamforming based on up-to-date information about the wireless medium. Through these and many other inventions, Vivato’s engineers pioneered a wireless technology that provides for simultaneous transmission and reception, a significant leap forward over conventional wireless technology.

14. Over the years, Vivato has developed proven technology, with over 400

deployments globally, including private, public and government, and it has become a recognized provider of extended range Wi-Fi network infrastructure solutions. Vivato's wireless base stations integrate beamforming phased array antenna design with packet steering technology to deliver high-bandwidth extended range connections to serve multiple users and multiple devices.

15. Vivato's patent portfolio includes over 17 issued patents and pending patent applications. The patents at issue in this case are directed to specific aspects of wireless communication, including adaptively steered antenna technology and beam switching technology.

16. Defendant Cisco Systems, Inc. ("Cisco" or "Cisco Systems") is a corporation organized under the laws of California with a place of business at 170 W. Tasman Dr., San Jose, CA 95134. Cisco Systems is registered to do business in the State of Texas. Cisco Systems has appointed Prentice-Hall Corporation System, Inc., 211 E. 7<sup>th</sup> St., Suite 620, Austin, TX 78701 as its agent for service of process. Cisco Systems maintains regular and established places of business and does business in Texas and in the Western District of Texas at its campuses at 12515-3 Research Park Loop, Austin, TX 78759, and/or at 18615 Tuscany Stone, San Antonio, TX 78258. By registering to conduct business in Texas and by having facilities where it regularly conducts business in this District, Cisco Systems has a permanent and continuous presence in Texas and a regular and established place of business in the Western District of Texas.

17. Defendant Meraki LLC ("Meraki") is a limited liability company organized under the laws of Delaware with a place of business at 500 Terry A Francois Blvd, San Francisco, CA 94158. Meraki LLC is registered to do business in the State of Texas. Defendant Meraki was acquired by and is a subsidiary of Cisco Systems. Meraki maintains regular and established places of business in this District, for example, at Cisco's campus at 12515-3 Research Park Loop, Austin, TX 78759. Cisco Meraki has several job openings related to Engineering in the Austin location.

For example, according to the web page available at [meraki.cisco.com/jobs](https://meraki.cisco.com/jobs), Cisco Meraki has a job opening for an Engineering Manager, Network Switching in Austin, as well as Senior Network Security Application Engineer in Austin. On information and belief, these job openings relate at least in part to Defendants' accused products at issue in this case. By registering to conduct business in Texas and by having facilities where it regularly conducts business in this District, Meraki has a permanent and continuous presence in Texas and a regular and established place of business in the Western District of Texas.

### **JURISDICTION AND VENUE**

18. This action arises under the patent laws of the United States, Title 35 of the United States Code § 1, *et seq.*, including 35 U.S.C. §§ 271, 281, 283, 284, and 285. This Court has original subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

19. This Court has personal jurisdiction over Defendants in this action because Defendants have committed acts within this District giving rise to this action, and have established minimum contacts with this forum such that the exercise of jurisdiction over Defendants would not offend traditional notions of fair play and substantial justice. Defendants, including both Cisco Systems and Meraki, directly and/or through subsidiaries or intermediaries, have committed and continue to commit acts of infringement in this District by, among other things, importing, offering to sell, and selling products that infringe the asserted patents, and inducing others to infringe the asserted patents in this District. Defendants, including both Cisco Systems and Meraki, is directly and through intermediaries making, using, selling, offering for sale, distributing, advertising, promoting, and otherwise commercializing its infringing products in this District. Defendants, including both Cisco Systems and Meraki, regularly conduct and solicit business in, engage in other persistent courses of conduct in, and/or derive substantial revenue from goods and services

provided to the residents of this District and the State of Texas. Cisco Systems is subject to jurisdiction pursuant to due process and/or the Texas Long Arm Statute due to its substantial business in this State and District including at least its infringing activities, regularly doing or soliciting business at its Austin and San Antonio facilities, and engaging in persistent conduct and deriving substantial revenues from goods and services provided to residents in the State of Texas including the Western District of Texas. Meraki LLC is subject to jurisdiction pursuant to due process and/or the Texas Long Arm Statute due to its substantial business in this State and District including at least its infringing activities, regularly doing or soliciting business at its Austin facilities, and engaging in persistent conduct and deriving substantial revenues from goods and services provided to residents in the State of Texas including the Western District of Texas.

20. Venue is proper in this District pursuant to 28 U.S.C. § 1391(b), (c), (d), and 1400(b) because Cisco Systems has a permanent and continuous presence in, has committed acts of infringement in, and maintains regular and established places of business in this district. Cisco Systems has committed acts of direct and indirect infringement in this judicial district including using and purposefully transacting business involving the Accused Products in this judicial district such as by sales to one or more customers in the State of Texas including in the Western District of Texas, and maintaining regular and established places of business in this district, as set forth above, including, *e.g.*, regular and established places of business in this District, for example, at Cisco's campus at 12515-3 Research Park Loop, Austin, TX 78759.

21. Venue is proper in this District pursuant to 28 U.S.C. § 1391(b), (c), (d), and 1400(b) because Meraki LLC has a permanent and continuous presence in, has committed acts of infringement in, and maintains regular and established places of business in this district, together with its parent, Cisco Systems. Meraki LLC has committed acts of direct and indirect infringement

in this judicial district including using and purposefully transacting business involving the Accused Products in this judicial district such as by sales to one or more customers in the State of Texas including in the Western District of Texas, and maintaining regular and established places of business in this district, as set forth above, including, *e.g.*, regular and established places of business in this District, for example, at the Cisco Systems / Meraki campus at 12515-3 Research Park Loop, Austin, TX 78759.

**COUNT I**

**INFRINGEMENT OF U.S. PATENT NO. 7,729,728**

22. Vivato realleges and incorporates by reference the foregoing paragraphs as if fully set forth herein.

23. On June 1, 2010, United States Patent No. 7,729,728 (“the ’728 Patent”) was duly and legally issued by the United States Patent and Trademark Office for inventions entitled “Forced Beam Switching in Wireless Communication Systems Having Smart Antennas.” Vivato owns the ’728 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the ’728 Patent is attached hereto as Exhibit A.

24. Defendant has directly infringed and continues to directly infringe numerous claims of the ’728 Patent, including at least claim 4, by manufacturing, using, selling, offering to sell, and/or importing into the United States Wi-Fi 6 access points and routers supporting MU-MIMO, including without limitation access points and routers utilizing the IEEE 802.11ax or “Wi-Fi 6” standard (e.g. Defendant’s Wi-Fi 6 Cisco Catalyst 9100 Series and Catalyst 9800 Series products, including Cisco Catalyst 9100, 9105w, 9105i, 9115, 9117, 9120, 9124, 9130 series, Cisco Catalyst 9800, 9800-L, 9800-CL, 9800-30, 9800-80, 9800 Embedded Wireless on Switch, 9800 Embedded Wireless on Access Point models, and Cisco Meraki MR36, MR44, MR45, MR46, MR46E,

MR55, MR56, MR76, MR86 models) (collectively the “’728 Accused Products”). Defendant is liable for infringement of the ’728 Patent pursuant to 35 U.S.C. § 271(a).

25. The ’728 Accused Products satisfy all claim limitations of Claims 3, 4, 5, and 12 of the ’728 Patent. The following paragraphs compare limitations of Claim 4 to an exemplary ’728 Accused Product, the Cisco Catalyst 9117 Series Wi-Fi 6. *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet<sup>1</sup>; *see, e.g.*, Cisco Catalyst 9100 and Wi-Fi 6 (802.11ax) – Customer FAQ.<sup>2</sup>

26. Each of the ’728 Accused Products perform a method for use in a wireless communication system. For example, as with each ’728 Accused Product, the Cisco Catalyst 9117 Series Wi-Fi 6 is used for wireless communications in an IEEE 802.11ax (Wi-Fi 6) wireless network. *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a

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<sup>1</sup> The Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet is available from at <https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/datasheet-c78-741989.html>

<sup>2</sup> Cisco Catalyst 9100 and Wi-Fi 6 (802.11ax) – Customer FAQ, available at <https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/nb-06-802-11ax-faq-cte-en.html>

built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it's easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”

27. The '728 Accused Products selectively allow a receiving device to operatively associate with a beam downlink transmittable to the receiving device via a phased array antenna of an access point. The Cisco Catalyst 9117 is an access point for use in an IEEE 802.11ax wireless network. Further, as with each '728 Accused Product, the Cisco Catalyst 9117 Access Point uses, includes, and/or is configurable as an access point with a phased array antenna and a Wi-Fi 6 radio that performs beamforming. *See, e.g.,* Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.,* Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are

available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it's easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.” *See, e.g., IEEE 802.11ax Standard*<sup>3</sup> at Section 27.3.5 (Transmitter block diagram). Further, the ’728 Accused Products, including the Cisco Catalyst 9117 Series selectively allow a receiving device (*e.g.*, station, abbreviated “STA”) to operatively associate (*e.g.*, connect) with a beam downlink transmittable to the receiving device (*e.g.*, SU-MIMO, DL MU-MIMO or UL MU-MIMO beamforming) via a phased array antenna of an access point. *See, e.g., IEEE 802.11ax Standard*, at Sections 9.3.1.22, 26.5, 26.5.1, 26.5.2, 26.5.3, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.10.7, 27.3.10.8, 27.3.10.9, 27.3.15, including Tables 27-19, 27-20, 27-21, 27-24, 27-25, 27-26, 27-27, 27-28, 27-29, Annex G at G.5, Annex Z. *See, e.g., IEEE 802.11ax Standard*, Section 27.3.1.1 (“The transmission within an RU in a PPDU may be single stream to one user, spatially multiplexed to one user (SU-MIMO), or spatially multiplexed to multiple users (MU-MIMO).”); Section 27.3.2.5 (“The number of users in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A. The allocated spatial streams for each user and the total number of spatial streams are indicated in the Spatial Configuration field

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<sup>3</sup> A reference to a Section of the IEEE 802.11ax Standard operates as an incorporation by reference of the same or corresponding Section in any Draft or Final version of the IEEE 802.11ax Standard.

of User field in HE-SIG-B containing the STA-ID of the designated MU-MIMO STA as defined in Table 27-29 (Spatial Configuration subfield encoding)...[i]f there is only one User field (see Table 27-27 (User field format for a non-MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of spatial streams for the user in the RU is indicated by the  $N_{STS}$  field in the User field. If there is more than one User field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of allocated spatial streams for each user in the RU is indicated by the Spatial Configuration field of the User field in HE-SIG-B.”); Section 27.3.2.6 (“UL MU transmissions are preceded by a Trigger frame or frame carrying a TRS Control subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield indicates the parameters, such as the duration of the HE TB PPDU, RU allocation, target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control) and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit an HE TB PPDU”); Section 27.3.10.8 (HE-SIG-B) (“The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource allocation information to allow the STAs to look up the corresponding resources to be used in the data portion of the frame.”); Section 27.3.15 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU of size greater than or equal to 106-tones”); Section 27.3.10.8.5 (HE-SIG-B per user content) (“The User Specific field consists of multiple User fields. The User fields follow the Common field of HE-SIG-B. The RU Allocation field in the Common field and the position of the User field in the User Specific field together identify the RU used to

transmit

a

STA's

data...

**Table 27-27—User field format for a non-MU-MIMO allocation**

Bit	Subfield	Number of bits	Description
B0–B10	STA-ID	11	Set to a value of the element indicated from TXVECTOR parameter STA_ID_LIST (see 26.11.1 (STA_ID_LIST)).
B11–B13	NSTS	3	Number of space-time streams. Set to the number of space-time streams minus 1.
B14	Beamformed	1	Use of transmit beamforming.  Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15–B18	MCS	4	Modulation and coding scheme  Set to $n$ for MCS $n$ , where $n = 0, 1, 2, \dots, 11$ Values 12 to 15 are reserved

...

**Table 27-28—User field for an MU-MIMO allocation**

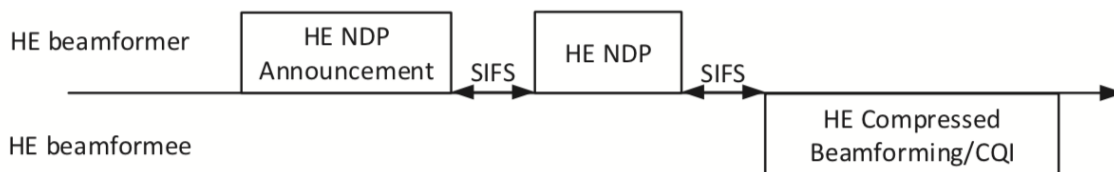
Bit	Subfield	Number of bits	Description
B0–B10	STA-ID	11	Set to a value of element indicated from TXVECTOR parameter STA_ID_LIST (see 26.11.1 (STA_ID_LIST)).
B11–B14	Spatial Configuration	4	Indicates the number of spatial streams for a STA in an MU-MIMO allocation (see Table 27-29 (Spatial Configuration subfield encoding)).
B15–B18	MCS	4	Modulation and coding scheme.  Set to $n$ for MCS $n$ , where $n = 0, 1, 2, \dots, 11$ Values 12 to 15 are reserved
B19	Reserved	1	Reserved and set to 0
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—If the STA-ID subfield is set to 2046, then the other subfields can be set to arbitrary values.			

;

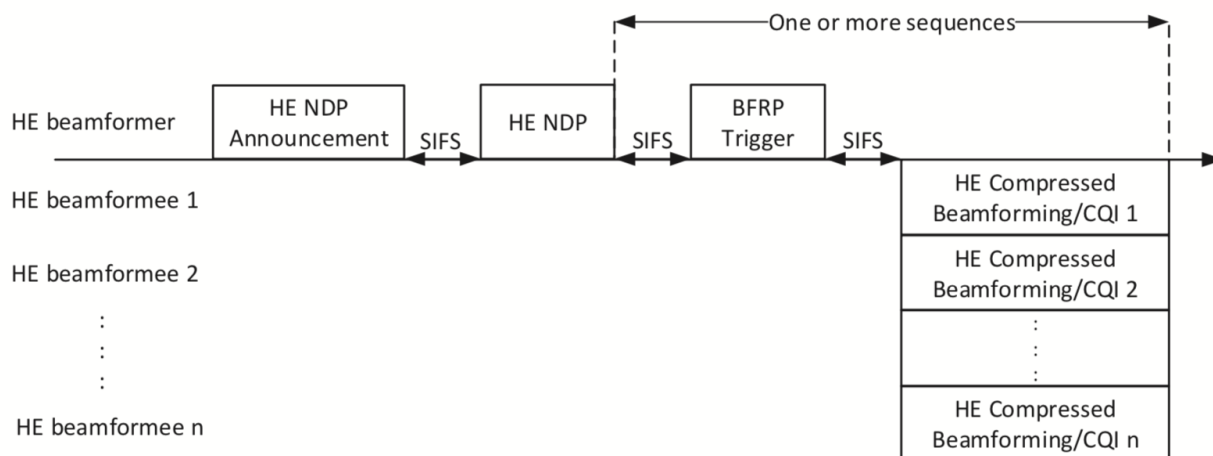
Section 9.3.1.22 (Trigger frame format) (“A Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions. The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the spatial streams of the solicited HE TB PPDU and the format is defined in Figure

9-64e (SS Allocation subfield format).”).

28. The ’728 Accused Products receive an uplink transmission from the receiving device through the phased array antenna. For example, as with each ’728 Accused Product, the Wi-Fi radio in Cisco Catalyst 9117 Wi-Fi 6 Series is operatively coupled to the phased array antenna and allows Cisco Catalyst 9117 Wi-Fi 6 Series to receive an uplink transmission (*e.g.*, receiving an uplink transmission in response to a trigger frame soliciting an uplink transmission, including, *e.g.*, HE TB PPDU, *e.g.*, HE TB feedback NDP, further including, *e.g.*, receiving an uplink transmission that includes information regarding an estimate of the channel state in, *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames) from the receiving device (*e.g.*, a STA, or HE beamformee) through the phased array antenna. *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1, 27.3.10.10. *See, e.g.*, Section 26.7 (HE sounding protocol) (“Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the HE beamformee measures the channel using a training signal (*i.e.*, an HE sounding NDP) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix. The HE beamformee returns an estimate of the channel state in an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames.”); Section 26.7.3, Figures 26-6 and 26-7:



**Figure 26-6—An example of the sounding protocol with a single HE beamformee**



**Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

; Section 26.7.3 (“An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee’s MAC address in the RA field and also receives an HE sounding NDP a SIFS after the HE NDP Announcement frame shall transmit its HE compressed beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR parameter CH\_BANDWIDTH for the PPDU containing the HE compressed beamforming/CQI report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH\_BANDWIDTH of the HE sounding NDP. An HE beamformee that receives an HE NDP Announcement frame as part of an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or MU feedback shall generate an HE compressed beamforming/CQI report using the feedback type,  $N_g$  and codebook size indicated in the STA Info field. If the HE beamformee then receives a BFRP Trigger frame with a User Info

field addressed to it, the HE beamformee transmits an HE TB PPDU containing the HE compressed beamforming/CQI report following the rules defined in 26.5.3.3 (Non-AP STA behavior for UL MU operation).”); Section 26.5.3 (UL MU operation) (“UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP HE STAs”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter provides training for  $N_{STS}$  space-time streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides training for  $N_{STS,r,total}$  space-time streams used for the transmission of the PSDU(s) in the  $r$ -th RU. In an HE TB PPDU, the transmitter of user  $u$  in the  $r$ -th RU provides training for  $N_{STS,r,u}$  space-time streams used for the transmission of the PSDU. For each tone in the  $r$ -th RU, the MIMO channel that can be estimated is an  $N_{RX} \times N_{STS,r,total}$  matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix  $P_{HE-LTF}$ , to enable channel estimation at the receiver.... In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”); Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The

feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the steering matrix  $Q_k$  can be determined from the beamforming feedback matrix  $V_k$  that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field.”).

29. The ’728 Accused Products determine from the uplink transmission if the receiving device should operatively associate with a different beam downlink transmittable via the phased array antenna. For example, as with each ’728 Accused Product, the Cisco Catalyst 9117 Wi-Fi 6 Series determines based on information from the uplink transmission (*e.g.*, an uplink transmission received in response to a trigger frame soliciting an uplink transmission, including, *e.g.*, HE TB PPDU, *e.g.*, HE TB feedback NDP, further including, *e.g.*, an uplink transmission that includes information regarding an estimate of the channel state in, *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames) if a client device (*e.g.*, a STA, or HE beamformee) should operatively associate with a different beam downlink transmittable via the phased array antenna. *See, e.g.*, IEEE 802.11ax Standard, at Sections 9.3.1.22, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.5, 26.5.1, 26.5.2, 26.5.3, 26.7, 26.7.1, 26.7.3, 26.7.3, 26.7.4, 26.7.5, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.10.7, 27.3.10.8, 27.3.10.9, 27.3.10.10, 27.3.15 – 27.3.15.3. *See, e.g.*, IEEE 802.11ax Standard at Section 26.7.1 (“Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute

a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the HE beamformee measures the channel using a training signal (i.e., an HE sounding NDP) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix.”); Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the steering matrix  $Q_k$  can be determined from the beamforming feedback matrix  $V_k$  that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field.”); Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”); Section 9.4.1.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of

delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”; Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter provides training for  $N_{STS}$  space-time streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides training for  $N_{STS,r,total}$  space-time streams used for the transmission of the PSDU(s) in the  $r$ -th RU. In an HE TB PPDU, the transmitter of user  $u$  in the  $r$ -th RU provides training for  $N_{STS,r,u}$  space-time streams used for the transmission of the PSDU. For each tone in the  $r$ -th RU, the MIMO channel that can be estimated is an  $N_{RX} \times N_{STS,r,total}$  matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix  $P_{HE-LTF}$ , to enable channel estimation at the receiver.... In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”).

30. The ’728 Accused Products allow the receiving device to operatively associate with

a different beam downlink if determining that the receiving device should operatively associate with the different beam downlink. For example, as with each '728 Accused Product, Cisco Catalyst 9117 Wi-Fi 6 Series allows the receiving device (e.g., STA or HE beamformee) to operatively associate with a different beam downlink if determining that the receiving device should operatively associate with the different beam downlink. *See, e.g., IEEE 802.11ax Standard*, at Sections 9.3.1.22, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.5, 26.5.1, 26.5.2, 26.5.3, 26.7, 26.7.1, 26.7.3, 26.7.3, 26.7.4, 26.7.5, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.10.7, 27.3.10.8, 27.3.10.9, 27.3.10.10, 27.3.15 – 27.3.15.3. *See, e.g., IEEE 802.11ax Standard*, Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix  $\mathbf{Q}_k = [\mathbf{Q}_{k,0}, \mathbf{Q}_{k,1}, \dots, \mathbf{Q}_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix  $\mathbf{Q}_k$  for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the steering matrix  $\mathbf{Q}_k$  can be determined from the beamforming feedback matrix  $\mathbf{V}_k$  that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field.”); Section 27.3.15.2 (“After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $\mathbf{V}_{k,u}$  using Equation (19-79). For SU-MIMO beamforming, the beamformer uses  $\mathbf{V}_{k,0}$  matrix to determine the steering matrix  $\mathbf{Q}_k$ . For DL MU-MIMO beamforming, the beamformer may calculate a steering matrix  $\mathbf{Q}_k = [\mathbf{Q}_{k,0}, \mathbf{Q}_{k,1}, \dots, \mathbf{Q}_{k,N_{user,r}-1}]$  using  $\mathbf{V}_{k,u}$  and Delta  $\Delta SNR_{k,u}$  ( $0 \leq u \leq N_{user,r} - 1$ ) in order to

suppress crosstalk between participating beamformers. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.”); Section 27.3.2.5 (Resource indication and User identification in an HE MU PPDU) (“The number of users in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A. The allocated spatial streams for each user and the total number of spatial streams are indicated in the Spatial Configuration field of User field in HE-SIG-B containing the STA-ID of the designated MU-MIMO STA as defined in Table 27-29 (Spatial Configuration subfield encoding)...[i]f there is only one User field (see Table 27-27 (User field format for a non-MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of spatial streams for the user in the RU is indicated by the  $N_{STS}$  field in the User field. If there is more than one User field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of allocated spatial streams for each user in the RU is indicated by the Spatial Configuration field of the User field in HE-SIG-B.”); Section 27.3.2.6 (“UL MU transmissions are preceded by a Trigger frame or frame carrying a TRS Control subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield indicates the parameters, such as the duration of the HE TB PPDU, RU allocation, target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control) and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit an HE TB PPDU.”); Section 9.3.1.22 (Trigger frame format) (“A Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions. The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the spatial streams of the solicited HE TB PPDU and the format is defined in Figure 9-64e (SS Allocation subfield format).”); Section 26.5.3.3.3 (TXVECTOR parameters for HE TB PPDU response to Trigger

frame).

31. The '728 Accused Products actively probe the receiving device by generating a signal to initiate that the phased array antenna transmits at least one downlink transmittable message over the different beam downlink, and gathering signal parameter information from uplink transmittable messages received from the receiving device through the phased array antenna. For example, as with each '728 Accused Product, the Cisco Catalyst 9117 Wi-Fi 6 Series actively probes the receiving device by generating a signal causing the phased array antenna to transmit at least one downlink transmittable message over the different beam downlink (*e.g.*, one or more messages sent to elicit a responsive uplink transmission from the receiving STA, including, *e.g.*, HE PPDU that carries a trigger frame, *e.g.*, messages soliciting feedback or including parameters for feedback from HE beamformee(s) such as, *e.g.*, messages pursuant to HE non-TB or HE TB sounding, such as, *e.g.*, NDP Announcement, HE sounding NDP frame, Trigger frame), and gathering signal parameter information (*e.g.*, information in an HE compressed beamforming/CQI report, RSSI, SNR, delta SNR measurements for spatial stream(s), or information gathered from training fields in uplink PPDU) from uplink transmittable messages received from the receiving device (*e.g.*, STA or HE beamformee) through the phased array antenna (*e.g.*, uplink transmittable messages received from the STA such as in response to a trigger frame soliciting an uplink transmission, including, *e.g.*, HE TB PPDU, further including, *e.g.*, an uplink transmission that includes information regarding an estimate of the channel state in, *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames). *See, e.g.*, IEEE 802.11ax Standard, Sections 9.6.31.2, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.7.1 – 26.7.5, 27.3.1, 27.3.1.1, 27.3.2.5, 27.3.2.6, 27.3.3, 27.3.3.1, 27.3.3.1.1, 27.3.3.1.2, 27.3.3.2.2, - 27.3.3.2.4, 27.3.4, 9.3.1.22, 26.5.3, 27.3.10.8, 27.3.10.8.5,

27.3.10.10, 27.3.15, 27.3.16, 27.3.17. *See, e.g.*, IEEE 802.11ax Standard, Section 26.7 (“Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the HE beamformee measures the channel using a training signal (i.e., an HE sounding NDP) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix.”); Section 27.3.2.5 (“HE-LTF symbols in the DL HE MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams.”); Section 27.3.4 (HE PPDU formats) (“Four HE PPDU formats are defined: HE SU PPDU, HE MU PPDU, HE ER SU PPDU, and HE TB PPDU. The HE sounding NDP is a variant of the HE SU PPDU and defined in 27.3.16 (HE sounding NDP). The HE TB feedback NDP is a variant of the HE TB PPDU and defined in 27.3.17 (HE TB feedback NDP)”); Section 27.3.10.10 (HE-LTF) (“The HT-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains.”); Section 26.5.3.3.3 (TXVECTOR parameters for HE TB PPDU response to Trigger frame); Section 27.3.2.6 (“UL MU transmissions are preceded by a Trigger frame or frame carrying a TRS Control subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield indicates the parameters, such as the duration of the HE TB PPDU, RU allocation, target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control) and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit an HE TB PPDU.”); Section 9.3.1.22 (Trigger frame format) (“A

Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions. The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the spatial streams of the solicited HE TB PPDU and the format is defined in Figure 9-64e (SS Allocation subfield format).”)

Section 27.2.2 (TXVECTOR and RXVECTOR parameters) (EXPANSION\_MAT, CHAN\_MAT, DELTA\_SNR, SNR, CQI, STBC, GI\_TYPE, RSSI, RSSI\_LEGACY, NUM\_STS, RU\_ALLOCATION, BEAMFORMED, HE\_LTF\_TYPE, HE\_LTF\_MODE, NUM\_HE\_LTF, STARTING\_STS\_NUM, PREAMBLE\_TYPE, TRIGGER\_METHOD, BEAM\_CHANGE, BSS\_COLOR, UPLINK\_FLAG, STA\_ID\_LIST, NDP\_REPORT, FEEDBACK\_STATUS, RU\_TONE\_SET\_INDEX); Section 26.5.3.2.4 (Allowed settings of the Trigger frame fields and TRS Control subfield) (“An AP shall transmit an HE PPDU that carries a Trigger frame or frame that includes a TRS Control subfield with the TXVECTOR parameter BEAM\_CHANGE set to 1.”). Section 26.5.3.3 (Non-AP STA behavior for UL MU operation) (“UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP STAs. A non-AP STA shall follow the rules in this subclause for the transmission of response frames in an HE TB PPDU unless the Trigger frame is an MU-RTS Trigger frame, in which case the response is a CTS frame sent in a non-HT PPDU (see 26.2.6 (MU-RTS Trigger/CTS frame exchange procedure)).”); Section 26.11 (Setting TXVECTOR parameters for an HE PPDU); Section 26.11.3 (BEAM\_CHANGE) (“An HE STA uses the TXVECTOR parameter BEAM\_CHANGE to indicate a change in the spatial mapping of the pre-HE-STF portion of the PPDU and the first symbol of HE-LTF (see Table 27-1 (TXVECTOR and RXVECTOR parameter)). An HE STA that transmits an HE SU PPDU or an HE ER SU PPDU shall set the TXVECTOR parameter BEAM\_CHANGE to 1 if one or more of the following conditions are met: - The number of spatial

streams is greater than 2; - The PPDU is the first PPDU in a TXOP; - The PPDU carries a Trigger frame.”).

32. The '728 Accused Products determine a current position of the receiving device relative to the phased array antenna from the uplink transmission received from the receiving device through the phased array antenna. For example, as with each '728 Accused Product, the Cisco Catalyst 9117 Wi-Fi 6 Series determines a current position of the receiving device (*e.g.*, STA or HE beamformee) relative to the phased array antenna from the uplink transmission received from the receiving device through the phased array antenna (*e.g.*, uplink transmission received from the STA such as in response to a trigger frame soliciting an uplink transmission, including, *e.g.*, HE TB PPDUs, further including, *e.g.*, an uplink transmission that includes information regarding an estimate of the channel state in, *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points

provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it's easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”); *See, e.g.*, IEEE 802.11ax Standard, Sections 9.6.31.2, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.7.1 – 26.7.5, 27.3.1, 27.3.1.1, 27.3.2.5, 27.3.2.6, 27.3.3, 27.3.3.1, 27.3.3.1.1, 27.3.3.1.2, 27.3.3.2.2, - 27.3.3.2.4, 27.3.4, 9.3.1.22, 26.5.3, 27.3.10.8, 27.3.10.8.5, 27.3.10.10, 27.3.15, 27.3.16, 27.3.17, Table 27-1. *See, e.g.*, IEEE 802.11ax Standard, at Section 27.3.1.1 (“The transmission within an RU in a PPDU may be single stream to one user, spatially multiplexed to one user (SU-MIMO), or spatially multiplexed to multiple users (MU-MIMO).”); Section 27.3.10.10 (HE-LTF) (“The HT-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains.”); Section 27.3.15 (SU-MIMO and DL-MIMO beamforming); Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU of size greater than or equal to 106-tones.”); Section 27.3.15.2 (“After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (19-79). For SU-MIMO beamforming, the

beamformer uses  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  using  $V_{k,u}$  and Delta  $\Delta SNR_{k,u}$  ( $0 \leq u \leq N_{user,r}-1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.”).

33. Defendant also has been and is now knowingly and intentionally inducing infringement of claims 3, 4, 5, and 12 of the ’728 Patent in violation of 35 U.S.C. § 271(b). Prior to the filing and service of this Complaint, Defendant has had knowledge of the ’728 Patent and the infringing nature of the ’728 Accused Products. Defendant had knowledge of Vivato’s ’728 Patent by at least the filing of the Complaint for patent infringement on April 19, 2017 and waiver of service of said complaint by Defendant on May 24, 2017 in the United States District Court for the Central District of California, Case No. 2:17-cv-2948.

34. Despite this knowledge of the ’728 Patent, Defendant continues to actively encourage and instruct its customers and end users (for example, through user manuals and online instruction materials on its website) to use the ’728 Accused Products in ways that directly infringe the ’728 Patent. For example, Defendant’s website provided, and continues to provide, instructions for using the ’728 Accused Products on wireless communications systems, and to utilize their 802.11ax beamforming and MU-MIMO functionalities. Defendant does so knowing and intending that its customers and end users will commit these infringing acts. Defendant also continues to make, use, offer for sale, sell, and/or import the ’728 Accused Products, despite its knowledge of the ’728 Patent, thereby specifically intending for and inducing its customers to infringe the ’728 Patent through the customers’ normal and customary use of the ’728 Accused Products. Defendant also knew or was willfully blind that its actions would induce direct infringement by others and

intended that its actions would induce direct infringement by others. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of Vivato's '728 Patent in the United States because Defendant had knowledge of the '728 Patent and actively induced others (*e.g.*, its customers) to directly infringe the '728 Patent.

35. Defendant also contributorily infringes by making, using, selling, offering to sell, and/or importing the '728 Accused Products, knowing they constitute a material part of the invention, are especially made or adapted for use in infringing, and that they are not staple articles of commerce capable of substantial non-infringing use.

36. By making, using, offering for sale, selling and/or importing into the United States the '728 Accused Products, Defendant has injured Vivato and is liable for infringement of the '728 Patent pursuant to 35 U.S.C. § 271.

37. Defendant also infringes claims 3, 5, and 12 of the '728 Patent, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 4.

38. Vivato's '728 Patent is valid and enforceable.

39. Vivato has complied with 35 U.S.C. § 287 and it does not preclude the recovery of pre-suit damages at least because Vivato only asserts method claims of the '728 Patent.

40. As a result of Defendant's infringement of the '728 Patent, Defendant has damaged Vivato, and Vivato is entitled to monetary damages in an amount to be determined at trial that is adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

41. Defendant's infringing activities have injured and will continue to injure Vivato,

unless and until this Court enters an injunction prohibiting further infringement of the '728 Patent, and, specifically, enjoining further manufacture, use, sale, importation, and/or offers for sale that come within the scope of the patent claims.

**COUNT II**

**INFRINGEMENT OF U.S. PATENT NO. 10,594,376**

42. Vivato realleges and incorporates by reference the foregoing paragraphs as if fully set forth herein.

43. On March 17, 2020, United States Patent No. 10,594,376 (“the ’376 Patent”) was duly and legally issued for inventions entitled “Directed Wireless Communication.” Vivato owns the ’376 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the ’376 Patent is attached hereto as Exhibit B.

44. Defendant has directly infringed and continues to directly infringe numerous claims of the ’376 Patent, including at least claim 1, by manufacturing, using, selling, offering to sell, and/or importing into the United States Wi-Fi 6 access points and routers supporting MU-MIMO, including without limitation access points and routers utilizing the IEEE 802.11ax or “Wi-Fi 6” standard (e.g. Defendant’s Cisco Catalyst 9100 Series and Catalyst 9800 Series products, including Cisco Catalyst 9100, 9105w, 9105i, 9115, 9117, 9120, 9124, 9130 models, Cisco Catalyst 9800, 9800-L, 9800-CL, 9800-30, 9800-80, 9800 Embedded Wireless on Switch, 9800 Embedded Wireless on Access Point models, and Cisco Meraki MR36, MR44, MR45, MR46, MR46E, MR55, MR56, MR76, MR86 models) and access points and routers supporting MU-MIMO utilizing the IEEE 802.11ac-2013 standard (Defendant’s Aironet 1562I, Aironet 1562E, Aironet 1562D, Aironet 1810, Aironet 1810W, Aironet 1815I, Aironet 1830I, Aironet 1850I, Aironet 1850E, Aironet 3800I, Aironet 3800E, Aironet 3800P, Aironet 2800I, Aironet 2800E, MR30H,

MR33, MR42, MR52, MR53, MR74, MR84, Aironet 1852E, Aironet 1852I, Aironet 1832I, Aironet 1810W, Aironet 2802I, Aironet 2802E, Aironet 3802I, Aironet 3802E, Cisco Aironet 4800 Series Access Points, Cisco Aironet 3800 Series Access Points, Cisco Aironet 2800 Series Access Points, Cisco 8540 Wireless Controller) (collectively the “’376 Accused Products”). Defendant is liable for infringement of the ’376 Patent pursuant to 35 U.S.C. § 271(a).

45. The ’376 Accused Products satisfy all claim limitations of numerous claims of the ’376 Patent, including Claim 1. The following paragraphs compare limitations of Claim 1 to an exemplary ’376 Accused Product, the Cisco Catalyst 9117 Series Wi-Fi 6 Access Point. *See, e.g., Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet.*<sup>4</sup>

46. Each of the ’376 Accused Products comprises a data-communications networking apparatus. For example, as with each ’376 Accused Product, the Cisco Catalyst 9117 Series Wi-Fi 6 Access Point is an apparatus for communication data on an IEEE 802.11ax / Wi-Fi 6 data communications network. *See, e.g., Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet*, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g., Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet* which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4

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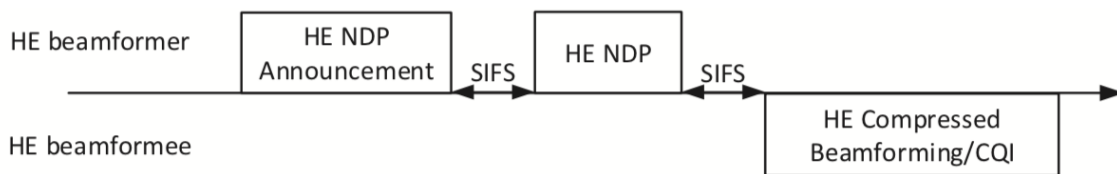
<sup>4</sup> The Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet is available from at <https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/datasheet-c78-741989.html>

GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”).

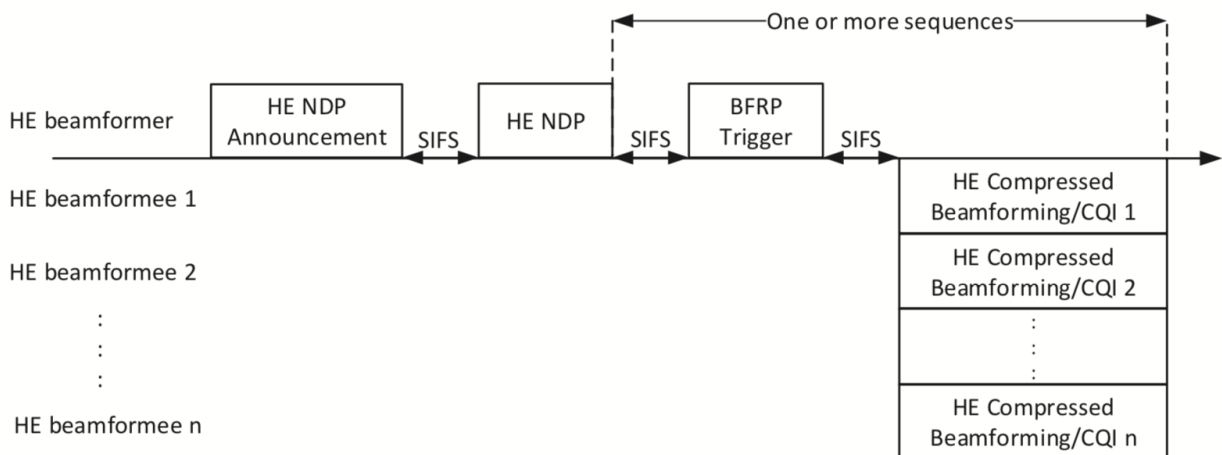
47. Each of the ’376 Accused Products comprises a processor configured to generate a probing signal for transmission to at least a first client device and a second client device. For example, as with each ’376 Accused Product, the Cisco Catalyst 9117 Series has at least one processor (*e.g.*, one or more central processing units (CPUs), Wi-Fi processors, a baseband processor in the Wi-Fi 6 radio, as examples) for generating signals for transmission. *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated

Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”). For a further example, as with each ’376 Accused Product, the Cisco Catalyst 9117 Access Point generates a probing signal for transmission (*e.g.*, a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement, HE sounding NDP, Beamforming Report trigger frames pursuant to High Efficiency (HE) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO) to at least a first client device and a second client device (*e.g.*, a first non-AP STA / HE beamformee and a second non-AP STA / HE beamformee). *See, e.g.*, IEEE 802.11ax: The Sixth Generation of Wi-Fi, Technical white paper, authored by Cisco and/or its affiliates, 2020 (“Most importantly, 802.11ax 2.4-GHz support significantly increases the range of Wi-Fi, adding standards-based sounding and beamforming, and enabling new use cases and business models for indoor and outdoor coverage.”); *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1. *See, e.g.*, Section 26.7 (HE sounding protocol) (“Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal

to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the HE beamformee measures the channel using a training signal (i.e., an HE sounding NDP) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix. The HE beamformee returns an estimate of the channel state in an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames.”); Section 26.7.3, Figures 26-6 and 26-7:



**Figure 26-6—An example of the sounding protocol with a single HE beamformee**



**Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

; Section 26.7.3 (“An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee’s MAC address

in the RA field and also receives an HE sounding NDP a SIFS after the HE NDP Announcement frame shall transmit its HE compressed beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR parameter CH\_BANDWIDTH for the PPDU containing the HE compressed beamforming/CQI report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH\_BANDWIDTH of the HE sounding NDP. An HE beamformee that receives an HE NDP Announcement frame as part of an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or MU feedback shall generate an HE compressed beamforming/CQI report using the feedback type,  $N_g$  and codebook size indicated in the STA Info field. If the HE beamformee then receives a BFRP Trigger frame with a User Info field addressed to it, the HE beamformee transmits an HE TB PPDU containing the HE compressed beamforming/CQI report following the rules defined in 26.5.3.3 (Non-AP STA behavior for UL MU operation).”); Section 26.5.3 (UL MU operation) (“UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP HE STAs”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter provides training for  $N_{STS}$  space-time streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides training for  $N_{STS,r,total}$  space-time streams used for the transmission of the PSDU(s) in the  $r$ -th RU. In an HE TB PPDU, the transmitter of user  $u$  in the  $r$ -th RU provides training for  $N_{STS,r,u}$  space-time streams used for the transmission of the PSDU. For each tone in the  $r$ -th RU, the MIMO channel that can be estimated is an  $N_{RX} \times N_{STS,r,total}$  matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix  $P_{HE-LTF}$ , to enable channel

estimation at the receiver.... In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”); Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the steering matrix  $Q_k$  can be determined from the beamforming feedback matrix  $V_k$  that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field.”). Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”); Section 9.4.1.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of

delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”; Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.”). For a further example, as with each ’376 Accused Product, the Cisco Catalyst 9117 Series Access Points generates a probing signal for transmission (*e.g.*, a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement pursuant to Very High Throughput (VHT) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO) to at least a first client device and a second client device (*e.g.*, a first non-AP STA / VHT beamformee and a second non-AP STA / VHT beamformee). See, *e.g.*, 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field.”); *id.* (“A non-AP VHT beamformee that receives a VHT NDP Announcement frame... shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer.”); *id.* Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); *id.*

Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each SNR value per tone in stream  $i$  (before being averaged) corresponds to the SNR associated with the column  $i$  of the beamforming feedback matrix  $V$  determined at the beamformee”); id. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); id. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.8.3.5; id. Clause 22.3.11.2.

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix,  $V_{k,u}$ , found by the beamformee  $u$  for subcarrier  $k$  shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles,  $\phi(k,u)$  and  $\psi(k,u)$ , are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows ( $N_r$ ) equal to the  $N_{STS}$  of the NDP.

After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  using  $V_{k,u}$  and  $SNR_{k,u}$  ( $0 \leq u \leq N_{user} - 1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.

48. Each of the '376 Accused Products comprises a processor configured to generate a first data stream for transmission to the first client device and generate a second data stream for transmission to the second client device. For example, as with each '376 Accused Product, the Cisco Catalyst 9117 Series has at least one processor and Wi-Fi 6 radio functionality (*e.g.*, the CPU(s) and/or Wi-Fi processors and/or baseband processor(s) in the Wi-Fi 6 radio) configured to generate a first data stream for transmission to the first client device (“non-AP STA” or “non-Access Point Station”) and a second data stream for transmission to a second client device (non-AP STA) pursuant to MU-MIMO transmissions. *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco

Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”).

*See, e.g.,* IEEE 802.11ax Standard, at Sections 26.5, 26.5.1, 26.5.2, 26.5.3, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.6.11.4, 27.3.10.7, 27.3.10.8, 27.3.10.9, 27.3.15, including Tables 27-19, 27-20, 27-21, 27-24, 27-25, 27-26, 27-27, 27-28, 27-29, Figures 27-19, 27-20, and other transmitter block diagrams for MU-MIMO transmission. *See, e.g.,* Section 27.1.1 (“The HE PHY extends the maximum number of users supported for DL MU-MIMO transmissions up to 8 users per resource unit (RU) and provides support for DL and UL orthogonal frequency division multiple access (OFDMA) as well as for UL MU-MIMO. Both DL and UL MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106

tones). In an MU-MIMO resource unit, there is support for up to 8 users with up to 4 space-time streams per user with the total not exceeding 8 space-time streams”); Section 27.3.1.1 (“DL MU transmission allows an AP to simultaneously transmit information to more than one non-AP STA. For a DL MU transmission, the AP uses the HE MU PPDU format and employs either DL OFDMA, DL MU-MIMO, or a mixture of both.”); Section 27.3.10.8.1 (“The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource allocation information to allow the STAs to look up the corresponding resources to be used in the data portion of the frame.”); Section 27.3.2.5 (“If there is more than one User field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of allocated spatial streams for each user in the RU is indicated by the Spatial Configuration field of the User field in HE-SIG-B...In each HE-SIG-B content channel, the User fields are first ordered in the order of RUs (from lower frequency to higher frequency) as described by the RU Allocation field if the HE-SIG-B contains the Common field. If an RU has multiple User fields in an HE-SIG-B content channel, the User fields of the RU are ordered in the order of spatial stream index, from lower to higher spatial stream, as indicated in the Spatial Configuration field. The STA-ID field in each User field indicates the intended recipient user of the corresponding spatial streams and the RU.”); *See, e.g.*, IEEE 802.11ax Standard, Section 27.3.5 (Transmitter block diagram), at, *e.g.*, Figure 27-19:

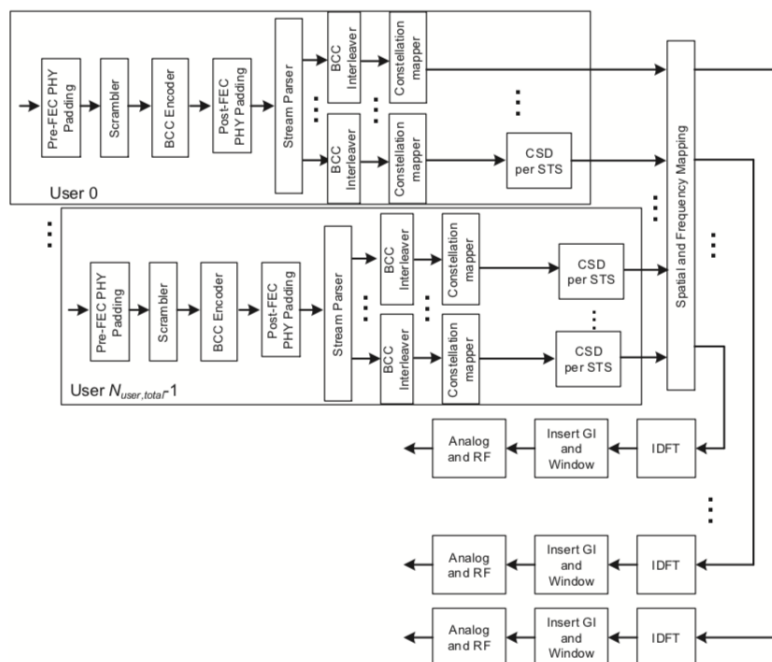


Figure 27-19—Transmitter block diagram for the Data field of an HE DL MU-MIMO transmission in a 106-, 242-, 484- or 996-tone RU with BCC encoding

See, e.g., Section 27.3.6.11.4 – 27.3.7:

#### 27.3.6.11.4 Combining to form an HE MU PPDU

The per user data is combined as follows:

- Spatial mapping: The  $Q$  matrix is applied as described in 27.3.11.14 (OFDM modulation). The combining of all user data of an RU is done in this block.
- IDFT: Compute the inverse discrete Fourier transform.
- Insert GI and apply windowing: Prepend a GI determined by the TXVECTOR parameter GI\_TYPE and apply windowing as described in 27.3.9 (Mathematical description of signals).
- Analog and RF: Upconvert the resulting complex baseband waveform with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 27.3.9 (Mathematical description of signals) and 27.3.10 (HE preamble) for details.

#### 27.3.7 HE modulation and coding schemes (HE-MCSs)

The HE-MCS is a compact representation of the modulation and coding used in the Data field of the PPDU. For an HE SU PPDU and an HE ER SU PPDU it is carried in the HE-SIG-A field. For an HE MU PPDU it is carried per user in the User Specific field of the HE-SIG-B field. For an HE TB PPDU, it is carried in the User Info field of the Trigger frame soliciting the HE TB PPDU.

For a further example, as with each '376 Accused Product, the Cisco Catalyst 9117 Series has at least one processor and Wi-Fi radio functionality (e.g., the 1.5GHz CPU and/or baseband

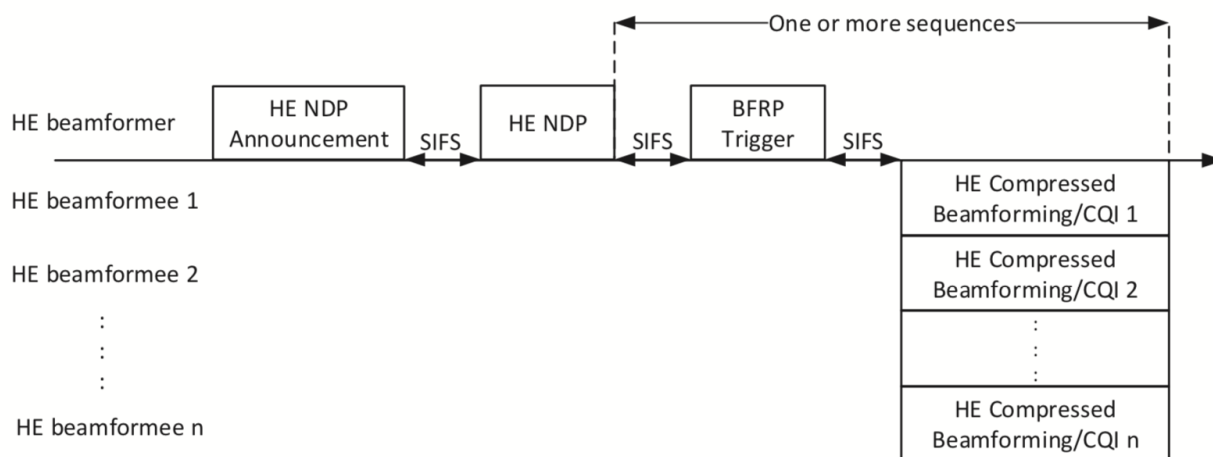
processor(s) in the Wi-Fi radio) configured to generate a first data stream for transmission to the first client device (“non-AP STA” or “non-Access Point Station”) and a second data stream for transmission to a second client device (non-AP STA) pursuant to MU-MIMO transmissions. See, e.g., 802.11ac Standard Clause 9.31.5.1 (“Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix.”); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1, 22.3.11.2.

49. Each of the '376 Accused Products comprises a transceiver operatively coupled to the processor and configured to: transmit the probing signal to at least the first client device and the second client device via a smart antenna; wherein the smart antenna is operatively coupled to the transceiver and comprises a first antenna element and a second antenna element. For example, as with each '376 Accused Product, the Cisco 9117 Series has a Wi-Fi 6 radio with a transceiver operatively coupled to the processor (*e.g.*, the Wi-Fi 6 radio generates signals for transmission and processes received signals with, *e.g.*, the CPU, Wi-Fi processors, and/or baseband processor in the Wi-Fi 6 radio, and the radio comprises a transceiver that transmits and receives signals via a smart

antenna); and, as with each '376 Accused Product, the Cisco 9117 Series has a Wi-Fi 6 radio transceiver operatively coupled to the processor and to a smart antenna, wherein the smart antenna is operatively coupled to the Wi-Fi 6 radio and comprises a first antenna element and a second antenna element. *See, e.g., See, e.g.,* Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.,* Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”). For a further example, as with each '376 Accused Product, the Cisco 9117 Series transmits the probing signal (*e.g.,* a probing signal transmission that triggers or elicits a responsive transmission from each of

a first client device and a second client device, such as NDP Announcement, HE sounding NDP, Beamforming Report trigger frames pursuant to High Efficiency (HE) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO) to at least the first client device and the second client device (*e.g.*, the first non-AP STA and the second non-AP STA) via the smart antenna. *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1. *See, e.g.*, Section 26.7.5 (HE sounding NDP transmission) (setting forth TXVECTOR parameters for HE sounding NDP); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter provides training for  $N_{STS}$  space-time streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides training for  $N_{STS,r,total}$  space-time streams used for the transmission of the PSDU(s) in the  $r$ -th RU. In an HE TB PPDU, the transmitter of user  $u$  in the  $r$ -th RU provides training for  $N_{STS,r,u}$  space-time streams used for the transmission of the PSDU. For each tone in the  $r$ -th RU, the MIMO channel that can be estimated is an  $N_{RX} \times N_{STS,r,total}$  matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix  $P_{HE-LTF}$ , to enable channel estimation at the receiver.... In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-LTF

types and GI durations are listed in 27.3.4 (HE PPDU formats.”). *See, e.g.*, Section 26.7.3, Figure 26-7:



**Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.”). *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include

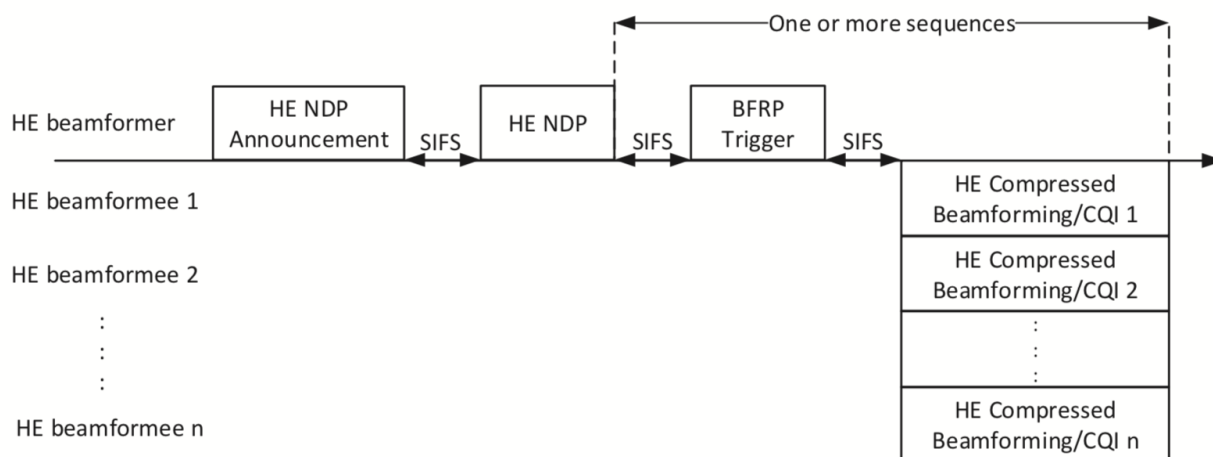
in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field.”); id. (“A non-AP VHT beamformee that receives a VHT NDP Announcement frame... shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer.”); id. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); id. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each SNR value per tone in stream  $i$  (before being averaged) corresponds to the SNR associated with the column  $i$  of the beamforming feedback matrix  $V$  determined at the beamformee”); id. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); id. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.8.3.5; id. Clause 22.3.11.2.

50. Each of the '376 Accused Products comprises a data-communications networking apparatus wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: receive a first feedback information from the first client device in response to the transmission of the probing signal; receive a second feedback information from the second client device in response to transmission of the probing signal. For example, as with each '376 Accused Product, the Cisco 9117 Series comprises one or more of the processor, the transceiver, or the smart antenna further configured to receive channel state information and estimates of the channel state and MU MIMO-related feedback information from each of the first non-AP STA and the second non-AP STA pursuant to HE MU-MIMO sounding procedures. This feedback information, carried in one or more HE Compressed Beamforming/CQI frames, is in response to the

transmission of the probing signal (*e.g.*, a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement, HE sounding NDP, Beamforming Report trigger frames pursuant to High Efficiency (HE) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO). *See, e.g., See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”). *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67,

9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1, 27.3.15.1 – 27.3.15.3. *See, e.g.*, Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.”); Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU of size greater than or equal to 106-tones...The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might

replace the existing steering matrix  $Q_k$  for the next DL MU-MIMO data transmission.”); Section 27.3.15.2 (“Upon receipt of an HE sounding NDP, the beamformee computes a set of matrices for feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback Matrix V). The eligible beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the measured channel before computing a set of matrices for feedback to the beamformer.”); *See, e.g.*, Section 26.7.3, Figure 26-7:



**Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

For a further example, as with each '376 Accused Product, the Cisco Catalyst 9117 Series comprises one or more of the processor, the transceiver, or the smart antenna further configured to receive channel state information and estimates of the channel state and MU MIMO-related feedback information from each of the first non-AP STA and the second non-AP STA pursuant to MU-MIMO sounding procedures. This feedback information, carried in one or more compressed beamforming frames, is in response to the transmission of the probing signal (*e.g.*, a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement pursuant to Very High Throughput (VHT) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO). *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer shall initiate a

sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field.”); id. (“A non-AP VHT beamformee that receives a VHT NDP Announcement frame... shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer.”); id. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); id. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each SNR value per tone in stream  $i$  (before being averaged) corresponds to the SNR associated with the column  $i$  of the beamforming feedback matrix  $V$  determined at the beamformee”); id. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); id. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.8.3.5; id. Clause 22.3.11.2:

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix,  $V_{k,u}$ , found by the beamformee  $u$  for subcarrier  $k$  shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles,  $\phi(k,u)$  and  $\psi(k,u)$ , are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows ( $Nr$ ) equal to the  $N_{STS}$  of the NDP.

After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  using  $V_{k,u}$  and  $SNR_{k,u}$  ( $0 \leq u \leq N_{user} - 1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.

51. Each of the '376 Accused Products comprises a data-communications networking apparatus wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information. For example, as with each '376 Accused Product, the Cisco 9117 Series comprises one or more of the processor, the transceiver, or the smart antenna further configured to determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information, including, *e.g.*, where it determines where to place transmission peaks and transmission nulls through a beamforming steering matrix pursuant to beamforming and MU-MIMO spatial multiplexing, which beamforming steering matrix is determined based on the received CSI (channel state information) and MIMO-related feedback from the first client device (first non-AP STA) and the second client device (second non-AP STA) pursuant to HE MU-MIMO sounding. *See, e.g.*, IEEE 802.11ax: The Sixth Generation of Wi-Fi, Technical white paper, authored by Cisco and/or its affiliates, 2020 ("Most importantly, 802.11ax 2.4-GHz support significantly increases the range of Wi-Fi, adding standards-based sounding and beamforming, and enabling new use cases and business models for indoor and outdoor coverage."). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes "IEEE 802.11ax" Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: "new generation of Cisco Catalyst 9100 Access Points" include "high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics..."; "Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices,

to maximize throughput”; “8x8 MIMO with eight spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”). *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1, 27.3.15.1, 27.3.15.2, 27.3.15.3. *See, e.g.*, Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”; Section 9.1.4.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”; Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average

SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.”); Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU of size greater than or equal to 106-tones...The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL MU-MIMO data transmission.”); Section 27.3.15.2 (“Upon receipt of an HE sounding NDP, the beamformee computes a set of matrices for feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback Matrix  $V$ ). The eligible beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix  $V_{k,u}$  found by the beamformee  $u$  for subcarrier  $k$  in RU  $r$  shall be compressed in the form of angles using the method described in 19.3.12.3.6 (Compressed beamforming feedback matrix). The angles  $\phi(k,u)$  and  $\psi(k,u)$ , are quantized according to Table 9-68 (Quantization of angles).... The beamformee shall generate the beamforming feedback matrices with the number of rows ( $N_r$ ) equal to the  $N_{STS}$  of the HE sounding NDP. After receiving the angle

information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (19-79). For SU-MIMO beamforming, the beamformer uses  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  using  $V_{k,u}$  and Delta  $\Delta SNR_{k,u}$  ( $0 \leq u \leq N_{user,r}-1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.”). See, e.g., 802.11ac Standard Clause 9.31.5.1 (“Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix.”); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1

The DL-MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  can be determined by the beamformer using the beamforming feedback matrices for subcarrier  $k$  from beamformee  $u$ ,  $V_{k,u}$ , and SNR information for subcarrier  $k$  from beamformee  $u$ ,  $SNR_{k,u}$ , where  $u = 0, 1, \dots, N_{user}-1$ . The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

22.3.11.2,

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix,  $V_{k,u}$ , found by the beamformee  $u$  for subcarrier  $k$  shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles,  $\phi(k,u)$  and  $\psi(k,u)$ , are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows ( $N_r$ ) equal to the  $N_{STS}$  of the NDP.

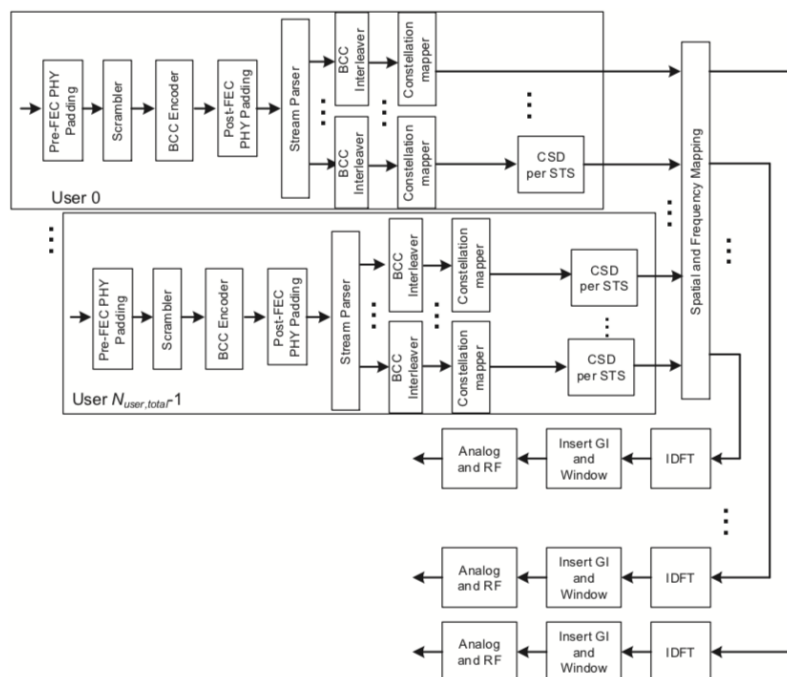
After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  using  $V_{k,u}$  and  $SNR_{k,u}$  ( $0 \leq u \leq N_{user} - 1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.

52. Each of the '376 Accused Products comprises a data-communications networking apparatus wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: transmit the first data stream to the first client device via the one or more spatially distributed patterns of electromagnetic signals; and transmit the second data stream to the second client device via the one or more spatially distributed patterns of electromagnetic signals; wherein transmission of the first data stream and transmission of at least part of the second data stream occur at the same time; and wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device and a second transmission peak at a location of the second client device. For example, as with each '376 Accused Product, the Cisco 9117 Series comprises one or more of the processor, the transceiver, or the smart antenna further configured to transmit the first data stream to the first client device (*e.g.*, the first non-AP STA) via the one or more spatially distributed patterns of electromagnetic signals (*e.g.*, transmission of data to the first non-AP STA pursuant to HE MU-MIMO beamforming where a beamforming steering matrix is applied); and transmit the second data stream to the second client device (*e.g.*, the second non-AP STA) via the one or more spatially

distributed patterns of electromagnetic signals (*e.g.*, transmission of data to the second non-AP STA pursuant to HE MU-MIMO beamforming where a beamforming steering matrix is applied); wherein transmission of the first data stream and transmission of at least part of the second data stream occur at the same time (*e.g.*, simultaneous HE DL MU-MIMO transmissions); and wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device and a second transmission peak at a location of the second client device (*e.g.*, through HE MU-MIMO beamforming, radio energy is directed at each of the first client device and the second client device to form a transmission peak at the location of each device, and including, *e.g.*, where the beamforming steering matrix is applied, a first space-time stream (“STS”) intended for reception at the first client device and a second STS intended for reception at the second client device is representative of a first transmission peak being placed at the location of the first client device and a second transmission peak being placed at the location of second client device). *See, e.g.*, IEEE 802.11ax: The Sixth Generation of Wi-Fi, Technical white paper, authored by Cisco and/or its affiliates, 2020 (“Most importantly, 802.11ax 2.4-GHz support significantly increases the range of Wi-Fi, adding standards-based sounding and beamforming, and enabling new use cases and business models for indoor and outdoor coverage.”). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet, which explains that Cisco Catalyst 9117 Series Wi-Fi 6 includes “IEEE 802.11ax” Network Standard support with advertised data rates of up to 5 Gbps (5 GHz). *See, e.g.*, Cisco Catalyst 9117 Series Wi-Fi 6 Data Sheet which provides: “new generation of Cisco Catalyst 9100 Access Points” include “high-performance Wi-Fi 6 (802.11ax) capabilities and innovations in RF performance, security, and analytics...”; “Supporting eight spatial streams, MU-MIMO enables access points to split spatial streams between client devices, to maximize throughput”; “8x8 MIMO with eight

spatial streams for 5-GHz band, 4x4 MIMO with four spatial streams for 2.4 GHz band, Downlink OFDMA, TWT, MRC, 802.11ax beamforming, 20-, 40-, 80-, and 160-MHz channels”; “Integrated antenna: 2.4 GHz”; “Integrated Antenna: 5 GHz”; “The 9117 Series Wi-Fi 6 access points are available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”; “The Cisco Catalyst 9117 Access Points deliver several features of Wi-Fi 6 while offering high data rates”; “Network infrastructure that upgrade to Wi-Fi 6, also known as 802.11ax, enabled devices will get up to 4x capacity boost needed to support the additional devices connected to the network as well as the data that they generate.”). *See, e.g.,* IEEE 802.11ax Standard, Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU of size greater than or equal to 106-tones...The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL MU-MIMO data transmission.”); Section 27.3.15.2

(“The beamformee shall generate the beamforming feedback matrices with the number of rows ( $Nr$ ) equal to the  $N_{STS}$  of the HE sounding NDP. After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (19-79). For SU-MIMO beamforming, the beamformer uses  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  using  $V_{k,u}$  and Delta  $\Delta SNR_{k,u}$  ( $0 \leq u \leq N_{user,r}-1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.”); Section 27.1.1 (“The HE PHY extends the maximum number of users supported for DL MU-MIMO transmissions up to 8 users per resource unit (RU) and provides support for DL and UL orthogonal frequency division multiple access (OFDMA) as well as for UL MU-MIMO. Both DL and UL MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106 tones). In an MU-MIMO resource unit, there is support for up to 8 users with up to 4 space-time streams per user with the total not exceeding 8 space-time streams”); Section 27.3.1.1 (“DL MU transmission allows an AP to simultaneously transmit information to more than one non-AP STA. For a DL MU transmission, the AP uses the HE MU PPDU format and employs either DL OFDMA, DL MU-MIMO, or a mixture of both.”); Section 27.3.10.8.1 (“The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource allocation information to allow the STAs to look up the corresponding resources to be used in the data portion of the frame.”); *See, e.g.*, IEEE 802.11ax Standard, Section 27.3.5 (Transmitter block diagram), at, *e.g.*, Figure 27-19:



**Figure 27-19—Transmitter block diagram for the Data field of an HE DL MU-MIMO transmission in a 106-, 242-, 484- or 996-tone RU with BCC encoding**

Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.”). See, e.g., 802.11ac Standard Clause 9.31.5.1 (“Transmit

beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix.”); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1

The DL-MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  can be determined by the beamformer using the beamforming feedback matrices for subcarrier  $k$  from beamformee  $u$ ,  $V_{k,u}$ , and SNR information for subcarrier  $k$  from beamformee  $u$ ,  $SNR_{k,u}$ , where  $u = 0, 1, \dots, N_{user} - 1$ . The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix  $Q_k$  for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

## 22.3.11.2

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix,  $V_{k,u}$ , found by the beamformee  $u$  for subcarrier  $k$  shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles,  $\phi(k,u)$  and  $\psi(k,u)$ , are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows ( $N_r$ ) equal to the  $N_{STS}$  of the NDP.

After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this  $V_{k,0}$  matrix to determine the steering matrix  $Q_k$ . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  using  $V_{k,u}$  and  $SNR_{k,u}$  ( $0 \leq u \leq N_{user} - 1$ ) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$  is implementation specific.

53. Defendant also has been and is now knowingly and intentionally inducing infringement of at least claim 1 of the '376 Patent in violation of 35 U.S.C. § 271(b). Through the filing and service of this Complaint, Defendant has had knowledge of the '376 Patent and the infringing nature of the '376 Accused Products.

54. Despite this knowledge of the '376 Patent, Defendant continues to actively encourage and instruct its customers and end users (for example, through user manuals and online instruction materials on its website) to use the '376 Accused Products in ways that directly infringe the '376 Patent. For example, Defendant's website provided, and continues to provide, instructions for using the Accused Products on wireless communications systems, and to utilize their 802.11ax beamforming and MU-MIMO functionalities. Defendant does so knowing and intending that its customers and end users will commit these infringing acts. Defendant also continues to make, use, offer for sale, sell, and/or import the '376 Accused Products, despite its knowledge of the '376 Patent, thereby specifically intending for and inducing its customers to infringe the '376 Patent through the customers' normal and customary use of the '376 Accused Products. Defendant also knew or was willfully blind that its actions would induce direct infringement by others and

intended that its actions would induce direct infringement by others. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of Vivato's '376 Patent in the United States because Defendant had knowledge of the '376 Patent and actively induced others (*e.g.*, its customers) to directly infringe the '376 Patent.

55. Defendant also contributorily infringes by making, using, selling, offering to sell, and/or importing the '376 Accused Products, knowing they constitute a material part of the invention, are especially made or adapted for use in infringing, and that they are not staple articles of commerce capable of substantial non-infringing use.

56. By making, using, offering for sale, selling and/or importing into the United States the '376 Accused Products, Defendant has injured Vivato and is liable for infringement of the '376 Patent pursuant to 35 U.S.C. § 271.

57. Defendant also infringes numerous additional claims of the '376 Patent, including Claims 2 – 34, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 1.

58. Vivato's '376 Patent is valid and enforceable.

59. As a result of Defendant's infringement of the '376 Patent, Defendant has damaged Vivato, and Vivato is entitled to monetary damages in an amount to be determined at trial that is adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

60. Defendant's infringing activities have injured and will continue to injure Vivato, unless and until this Court enters an injunction prohibiting further infringement of the '376 Patent,

and, specifically, enjoining further manufacture, use, sale, importation, and/or offers for sale that come within the scope of the patent claims.

### **COUNT III**

#### **INFRINGEMENT OF U.S. PATENT NO. 8,289,939**

61. Vivato realleges and incorporates by reference the foregoing paragraphs as if fully set forth herein.

62. On October 16, 2012, United States Patent No. 8,289,939 duly and legally issued for inventions entitled “Signal Communication Coordination.” Vivato owns the ’939 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the ’939 Patent is attached hereto as Exhibit C.

63. Defendants have directly infringed and continue to directly infringe numerous claims of the ’939 Patent, including at least claim 1, by manufacturing, using, selling, offering to sell, and/or importing into the United States certain Wi-Fi access points, routers, and controllers supporting Cisco CleanAir technology<sup>5</sup> and/or Meraki Auto RF<sup>6</sup> technologies (e.g., Defendants’ Cisco Catalyst 9100 Series Access Points, including Cisco Catalyst 9120, 9124, 9130 models including embedded wireless controller functionality, Cisco Catalyst 9800 Series Wireless Controllers, including 9800-L, 9800-CL, 9800-40, 9800-80, 9800 Embedded Wireless on Switch, 9800 Embedded Wireless on AP, Cisco Meraki Series supporting Meraki Auto RF and/or Auto Channel, including, *e.g.*, MR36, MR44, MR46, MR46E, MR45, MR55, MR56, MR76, MR84,

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<sup>5</sup> Cisco CleanAir Technology, available at <https://www.cisco.com/c/en/us/solutions/enterprise-networks/cleanair-technology/index.html>

<sup>6</sup> Meraki Auto RF: Wi-Fi Channel and Power Management, Last Updated April 2, 2021, available at [https://documentation.meraki.com/MR/Monitoring\\_and\\_Reporting/Location\\_Analytics/Meraki\\_Auto\\_RF%3A\\_\\_Wi-Fi\\_Channel\\_and\\_Power\\_Management](https://documentation.meraki.com/MR/Monitoring_and_Reporting/Location_Analytics/Meraki_Auto_RF%3A__Wi-Fi_Channel_and_Power_Management)

MR86, Aironet 3800I, Aironet 3800E, Aironet 3800P, Aironet 2800I, Aironet 2800E, MR30H, MR33, MR42, MR42E, MR52, MR53, MR53E, MR74, MR84, Cisco Aironet 4800 Series Access Points, Cisco Aironet 3800 Series Access Points, Cisco Aironet 2800 Series Access Points, Cisco 8540 Wireless Controller) (collectively, “’939 Accused Products). Defendants are liable for infringement of the ’939 Patent pursuant to 35 U.S.C. § 271(a).

64. The ’939 Accused Products satisfy all claim limitations of numerous claims of the ’939 Patent, including Claim 1. The following paragraphs compare limitations of Claim 1 to an exemplary ’939 Accused Product, Cisco Meraki MR36. *See, e.g., Cisco Meraki MR36 Data Sheet.*<sup>7</sup> The following paragraphs also compare limitations of Claim 1 to an exemplary Accused Product, the Cisco Catalyst 9120 Series Wi-Fi 6 Access Point with embedded wireless controller. *See, e.g., Cisco Catalyst 9120 Series Wi-Fi 6 Data Sheet.*<sup>8</sup> *See, e.g., Cisco Embedded Wireless Controller for an AP Data Sheet.*<sup>9</sup> *See, e.g., Cisco Embedded Wireless Controller product page.*<sup>10</sup>

65. Each ’939 Accused Product is an apparatus comprising a wireless input/output (I/O) unit that is configured to establish a plurality of access points. For example, as with each ’939 Accused Product, the Cisco Meraki MR36 is an apparatus comprising a wireless input/output (I/O) unit that is configured to establish a plurality of access points. *See, e.g., Cisco Meraki MR36 Data*

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<sup>7</sup> Cisco Meraki MR36 Data Sheet, available at <https://documentation.meraki.com/@api/deki/pages/1228/pdf/MR36%2bDatasheet.pdf>

<sup>8</sup> The Cisco Catalyst 9120 Series Wi-Fi 6 Data Sheet is available at <https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9120ax-series-access-points/datasheet-c78-742115.html>

<sup>9</sup> Cisco Embedded Wireless Controller for an AP Data Sheet (Dec. 8, 2020) available at <https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9800-series-wireless-controllers/nb-o6-embded-wrls-cont-ds-cte-en.html?oid=powen019337>

<sup>10</sup> Cisco Embedded Wireless Controller product page available at <https://www.cisco.com/c/en/us/products/wireless/embedded-wireless-controller-on-catalyst-access-points/index.html>

Sheet<sup>11</sup> (“The Cisco Meraki MR36 is a cloud-managed 2x2:2 802.11ax access point that raises the bar for wireless performance and efficiency. Designed for next generation deployments in offices, schools, hospitals, shops, and hotels, the MR36 offers high throughput, enterprise-grade security, and simple management. The MR36 provides a maximum of 1.7 Gbps\* aggregate frame rate with concurrent 2.4 GHz and 5 GHz radios. A dedicated third radio provides real-time WIDS/WIPS with automated RF optimization, and a fourth integrated radio delivers Bluetooth scanning and beaconing. With the combination of cloud management, high performance hardware, multiple radios, and advanced software features, the MR36 makes an outstanding platform for the most demanding of uses—including high-density deployments and bandwidth or performance-intensive applications like voice and high-definition video.”; “Dedicated third radio delivers 24x7 wireless security and RF analytics: The MR36’s dedicated dual-band scanning and security radio continually assesses the environment, characterizing RF interference and containing wireless threats like rogue access points. There’s no need to choose between wireless security, advanced RF analysis, and serving client data - a dedicated third radio means that all functions occur in real-time, without any impact to client traffic or AP throughput”; “Automatic cloud-based RF optimization: The MR36’s sophisticated and automated RF optimization means that there is no need for the dedicated hardware and RF expertise typically required to tune a wireless network. The RF data collected by the dedicated third radio is continuously fed back to the Meraki cloud. This data is then used to automatically tune the channel selection, transmit power, and client connection settings for optimal performance under even the most challenging RF conditions”).

66. The '939 Accused Products are apparatuses comprising a wireless input/output

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<sup>11</sup> Cisco Meraki MR36 Data Sheet, available at <https://documentation.meraki.com/@api/deki/pages/1228/pdf/MR36%2bDatasheet.pdf>

(I/O) unit that is configured to establish a plurality of access points. For example, as with each '939 Accused Product, the Cisco Catalyst 9120AX Series with embedded wireless controller is an apparatus comprising a wireless input/output (I/O) unit that is configured to establish a plurality of access points. *See, e.g.*, Cisco Catalyst 9120 Series Wi-Fi 6 Data Sheet (“Going beyond the Wi-Fi 6 (802.11ax) standard, the 9120AX Series provides integrated security, resiliency, and operational flexibility as well as increased network intelligence”; “Cisco RF ASIC is a fully integrated Software-Defined Radio (SDR) that can perform advanced RF spectrum analysis and delivers features like Cisco CleanAir®, Wireless Intrusion Prevention System (wIPS), Fast Locate\*, and DFS Detection”; “Supporting four spatial streams, Multiuser Multiple Input Multiple Output (MU-MIMO) enables access points to split spatial streams between client devices, to maximize throughput.”; “Uplink/Downlink OFDMA”; “Flexible Radio Assignment”; “Dual 5-GHz radio support”; “Smart antenna connector”; “Cisco Embedded Wireless Controller”; “The 9120AX Series Wi-Fi 6 access points is available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”). *See, e.g.*, Cisco DNA Spaces FAQ.<sup>12</sup> *See, e.g.*, Cisco Embedded Wireless Controller for an AP Data Sheet.<sup>13</sup> *See, e.g.*, Cisco Embedded

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<sup>12</sup> Cisco DNA Spaces FAQ (October 5, 2020) available at <https://www.cisco.com/c/en/us/solutions/collateral/enterprise-networks/dna-spaces/q-and-a-c67-741795.html>

<sup>13</sup> Cisco Embedded Wireless Controller for an AP Data Sheet (Dec. 8, 2020) available at <https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9800-series-wireless-controllers/nb-o6-embded-wrls-cont-ds-cte-en.html?oid=powen019337>

Wireless Controller product page.<sup>14</sup> *See, e.g.,* Cisco Clean Air Technology<sup>15</sup> (“Four of every five business report problems with radio frequency interference (RFI). Whether your network conforms to the Wi-Fi 5 or Wi-Fi 6 standard, Cisco CleanAir Technology identifies the source, location, and scope of RFI and can proactively guard against it.”; Supported Products include, *e.g.,* Cisco Catalyst 9100 Access Points).

67. Each ’939 Accused Product is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal. For example, as with each ’939 Accused Product, the Cisco Meraki MR36 is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal. *See, e.g.,* “High Density Wi-Fi Deployments,”<sup>16</sup> Cisco Meraki (“Auto Channel selection. Adding additional access points on the same channel with overlapping coverage does not increase capacity. To prevent

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<sup>14</sup> Cisco Embedded Wireless Controller product page available at <https://www.cisco.com/c/en/us/products/wireless/embedded-wireless-controller-on-catalyst-access-points/index.html>

<sup>15</sup> Cisco CleanAir Technology, available at <https://www.cisco.com/c/en/us/solutions/enterprise-networks/cleanair-technology/index.html>

<sup>16</sup> “High Density Wi-Fi Deployments,” Cisco Meraki, Last updated October 7, 2020, available at [https://documentation.meraki.com/Architectures\\_and\\_Best\\_Practices/Cisco\\_Meraki\\_Best\\_Practice\\_Design/Best\\_Practice\\_Design\\_-\\_MR\\_Wireless/High\\_Density\\_Wi-Fi\\_Deployments](https://documentation.meraki.com/Architectures_and_Best_Practices/Cisco_Meraki_Best_Practice_Design/Best_Practice_Design_-_MR_Wireless/High_Density_Wi-Fi_Deployments)

access points nearby from sharing the same channel, Cisco Meraki access points automatically adjusts the channels of the radios to avoid RF interference (Both 802.11 and non-802.11) and develop a channel plan for the Wireless Network. Channels can be selectively assigned to be used with each RF profile. By using channels selectively, network administrators can control the co-channel interference more effectively.”). *See, e.g.*, “Meraki Auto RF: Wi-Fi Channel and Power Management,” Cisco Meraki<sup>17</sup> (“Auto Channel dynamically adjusts the channels of the client-serving radios to avoid RF interference (both 802.11 and non-802.11) and develops a channel plan for the wireless network. Auto Channel is a good fit for most wireless networks, providing a baseline channel configuration that can then be adjusted manually if needed. This section outlines how Auto Channel operates and how to interpret channel change events. Configuration. Auto Channel is enabled by default on all Meraki access points. To ensure Auto Channel is enabled on an AP, navigate to Wireless > Configure > Radio settings in the dashboard and select a particular AP. The radio configuration for the access point will be displayed on the right-hand side of the page. The Auto Channel algorithm will be used on radios that have "Auto" selected for their channel and is performed every 15 minutes.... The dashboard offers the ability to set a default channel width, which will be factored into the Auto Channel algorithm for 5 GHz. This can be left at auto width which will adjust the width of the 5 GHz radio based on the Auto Channel algorithms discussed below. A default setting of 80 MHz width can be configured to allow for optimal wireless throughput. However, using an 80 MHz width may cause more co-channel contention. The setting can be may be reduced to 40 or 20 MHz to reduce channel overlap in high-density

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<sup>17</sup> Meraki Auto RF: Wi-Fi Channel and Power Management, Last Updated April 2, 2021, available at [https://documentation.meraki.com/MR/Monitoring\\_and\\_Reporting/Location\\_Analytics/Meraki\\_Auto\\_RF%3A\\_\\_Wi-Fi\\_Channel\\_and\\_Power\\_Management](https://documentation.meraki.com/MR/Monitoring_and_Reporting/Location_Analytics/Meraki_Auto_RF%3A__Wi-Fi_Channel_and_Power_Management)

deployments. The default channel width can be specified on the radio settings page in the dashboard under the drop-down if using the old view page and within the RF profile settings if viewing the new dashboard page. The width may be set differently on a per-AP basis, either using the overrides by selecting an AP or by opting to use Auto... Newer Cisco Meraki APs with a dedicated scanning radio are able to use the real-time Auto Channel algorithm. Since these APs have full visibility into RF conditions on all channels, the AP and the dashboard are able to make fast channel-planning decisions in high-density RF environments. RF Metrics. Cisco Meraki APs are constantly collecting information from the RF environment; the dedicated scanning radio continually monitors on all channels for Air Marshal and RF. The table below outlines in detail the metrics that are collected by each AP and analyzed by the cloud controller for the real-time Auto Channel algorithm... Channel adjustments are made by the dashboard using information reported by the deployed APs. The dashboard will instruct an AP to change to a different channel for a number of reasons, such as when a new AP is added, the "Update Auto Channels" button is pressed, the radio channels get jammed, during the steady-state process, and during channel switch announcements. The APs in a network will use the information they have gathered from the environment and will calculate to see if there are any channels that have better performance. If an AP determines there are better channels, the AP will switch to it when the Auto Channels update every 15 minutes.”). *See, e.g.,* “Auto RF,” Cisco Meraki Blog<sup>18</sup> (“The frequency spectrum that wireless networks operate in are shared frequency spectra; this is one of the reasons that Wi-Fi networks are so polite with one another. However, there are many more potential sources of interference, such as Bluetooth and microwave ovens in the 2.4GHz spectrum or medical scanners

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<sup>18</sup> “Auto RF”, Cisco Meraki Blog, Posted by Steve Harrison, March 21, 2018, available at <https://meraki.cisco.com/blog/2018/03/auto-rf/>

and radar in the 5GHz spectrum. These sources of interference can have a detrimental effect on the usability of wireless networks. Meraki Auto RF is a powerful and automated RF optimization solution that ensures that Meraki Aps create the best possible environment for the clients served. Listen and Learn. Auto RF is able to do this because all Meraki APs have a dedicated security radio that also provides visual spectrum analysis. The Meraki APs also share this data with the Auto RF algorithm to determine the optimal channel plan and transmit power appropriately. In addition to this, Meraki network administrators can also get access to real-time channel utilization scans from the live tools section of each and every AP, as shown below”; “Auto channel is enabled by default on Meraki networks...In order to tune the transmit channel, the APs track the following three things: Usage Demand – APs within the dashboard network are monitored for their usage demand, i.e. the number of clients and amount of traffic being served by the AP. These values are mathematically combined so that each AP has a weighted value. This value is then used to ensure that the cleanest channels are utilized in the most demanding areas. Airtime Availability – Each access point listens to the contention and airtime availability, i.e. free time in the medium, for each channel and bandwidth combination. When this data is aggregated it can be used to maximize the available airtime for all APs in the network, also known as the Basic Service Set (BSS), and also minimizes contention and improves client roaming performance. All visible APs — even neighboring APs — are considered in this metric, with Meraki APs being weighted higher to optimize roaming and airtime usage distribution. As opposed to just being polite (i.e. presuming they have as high a priority to the airtime as the Meraki AP and they’re clients) with respect to neighboring networks and APs, this metric ensures that the AP and its clients also have ample airtime availability. Channel Utilization – This metric includes both 802.11 and non-802.11 (Bluetooth, microwave ovens, etc.) sources of spectrum utilization. These external sources of

interference are detected and accounted for within this metric. The dashboard uses this information to tell the APs to move to a different channel if, say, a new AP is added, a channel becomes jammed, or the network administrator clicks the “Update Auto Channels” button...Channel moves can also be triggered by the “Steady State” process, which runs every 15 minutes. The Steady State process will instruct the AP to move channels if a better channel, based on the above criteria exists. However, the Steady State process is aware when a channel is being used for point-to-point communications and it will not change the channels of APs acting as a gateway AP...”)

68. Each ’939 Accused Product is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal. For example, as with each ’939 Accused Product, the Cisco 9120AX Series Access Point with embedded wireless controller is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal. *See, e.g.*, Cisco Catalyst 9120 Series Wi-Fi 6 Data Sheet (“Going beyond the Wi-Fi 6 (802.11ax) standard, the 9120AX Series provides integrated security, resiliency, and operational flexibility as well as increased network intelligence”; “Cisco RF ASIC is a fully integrated Software-Defined Radio (SDR) that can perform advanced RF spectrum analysis and delivers features like Cisco CleanAir<sup>®</sup>, Wireless Intrusion Prevention System (wIPS),

Fast Locate\*, and DFS Detection”; “Supporting four spatial streams, Multiuser Multiple Input Multiple Output (MU-MIMO) enables access points to split spatial streams between client devices, to maximize throughput.”; “Uplink/Downlink OFDMA”; “Flexible Radio Assignment”; “Dual 5-GHz radio support”; “Smart antenna connector”; “Cisco Embedded Wireless Controller”; “The 9120AX Series Wi-Fi 6 access points is available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”). *See, e.g.,* Cisco Clean Air Technology<sup>19</sup> (“Four of every five business report problems with radio frequency interference (RFI). Whether your network conforms to the Wi-Fi 5 or Wi-Fi 6 standard, Cisco CleanAir Technology identifies the source, location, and scope of RFI and can proactively guard against it.”). *See, e.g.,* Cisco CleanAir Technology At-a-Glance<sup>20</sup> (“Self-Healing and Self-Optimizing Wireless: With Cisco CleanAir technology, if an interference source is strong enough to completely jam a Wi-Fi channel, the system will change channels within seconds to avoid the interference, resuming client activity on another channel outside of the affected area. The system remembers intermittent interference from persistent sources such as a microwave ovens, wireless bridges, or wireless video cameras. Through tight integration with Cisco radio resource management technology, the CleanAir solution indicates the channels where these devices operate so that system administrators can optimize performance and minimize future disruption.”). *See,*

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<sup>19</sup> Cisco CleanAir Technology, available at <https://www.cisco.com/c/en/us/solutions/enterprise-networks/cleanair-technology/index.html>

<sup>20</sup> Cisco CleanAir Technology At-a-Glance, available at [https://www.cisco.com/c/dam/en/us/solutions/collateral/enterprise-networks/cleanair-technology/aag\\_c22-594304.pdf](https://www.cisco.com/c/dam/en/us/solutions/collateral/enterprise-networks/cleanair-technology/aag_c22-594304.pdf)

*e.g.*, “Interference Detection and Mitigation with Cisco CleanAir,”<sup>21</sup> Cisco Blogs (“Cisco CleanAir solution not only detects the source of interference, but also automatically changes the channel on which the WiFi network is operating to a channel clear of interference. This is done with a dedicated best-in-class spectrum analysis chip that resides within Cisco CleanAir Access Points. The built-in spectrum analysis chip and software does all the classification of devices. What is sent from the AP to the wireless controller and Prime Infrastructure (PI) management system are interferer records and channel air quality metrics. AirQuality is a metric that indicates how good a channel is for WiFi communication. The Air Quality Index is calculated right there in the AP and is measured on a scale from 1 – 100, where 100 is excellent and 1 is poor. In essence, AirQuality is a measurement of non-wifi and adjacent channel interference. Every device that is classified is assigned a severity, which is measured on a scale from 0 – 100. Severity of 0 means device is not severe and a value of 100 means device is extremely severe and can severely impact wireless communication. Severity accounts for the type of device, Duty Cycle and Power as measured at the radio. The AirQuality Index is derived from the severities of all interfering devices affecting the radio/serving channel. Interferers are classified and sent to the controller from the access points. Interferers don’t have digital signatures, so if more than one access points detects a single interferer, then each access point which hears it will report it as a separate interferer. The WLC will identify them as unique interferers despite being the same interferer, so there is a potential for the system to be flooded with duplicate interferer reports. To solve this problem, the controller has some merging and clustering algorithms in place so that only one Interferer is reported to MSE or PI. The controller forwards the interferer information to the Mobility Services

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<sup>21</sup> “Interference Detection and Mitigation with Cisco CleanAir,” Amit Hakoo, Cisco Blogs, available at <https://blogs.cisco.com/networking/interference-detection-and-mitigation-with-cisco-cleanair>

Engine, which has interferer location algorithms in place to locate the interferer on a map. Interferer information like Duty Cycle, affected channels and severity is presented whenever user hovers over any of the interferers on the map. **Figure 2.** An interferer ZOI (Zone Of Impact) metric is displayed as a circle where radius indicates the impact zone and opacity is the severity of the Interferer. If multiple interferers are close in proximity to one another, then their zones can overlap, thus increasing the opacity, which could indicate that the interference is severe enough in that zone to affect WiFi communication. **Figure 3.** With Cisco's CleanAir solution, you can not only detect which interferer is disrupting your WiFi, but also which channels it is affecting and where it is located. The same can be done for multiple sources of interference simultaneously. All this can be done with great accuracy which differentiates CleanAir solution with what the competition offers. Cisco Radio Resource Management consumes this information and helps in mitigating Interference issues by calculating alternate channel and power plans. There are a couple of mitigation approaches that RRM Module can use. One is Energy Detect RRM which works off the AirQuality metric on a per Access Point basis and the other is Persistent Device Avoidance where It does some predictive analysis so that access points stay away from channels where persistent interferers like microwave ovens are detected. Interference detection and mitigation is the complete solution that Cisco CleanAir provides. What is important to remember is that spectrum intelligence information is directly reported to RRM as an input and highly integrated into the resulting RRM solutions.”).

69. Each '939 Accused Product is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of

the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal, wherein the signal transmission/reception coordination logic restrains at least one other access point of the plurality of access points from transmitting the other signal on a first channel responsive to the ascertaining that the access point of the plurality of access points is receiving the signal on a second different channel. For example, as with each '939 Accused Product, the Cisco Meraki MR36 is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal, wherein the signal transmission/reception coordination logic restrains at least one other access point of the plurality of access points from transmitting the other signal on a first channel responsive to the ascertaining that the access point of the plurality of access points is receiving the signal on a second different channel. *See, e.g.*, “High Density Wi-Fi Deployments,” Cisco Meraki (“Auto Channel selection. Adding additional access points on the same channel with overlapping coverage does not increase capacity. To prevent access points nearby from sharing the same channel, Cisco Meraki access points automatically adjusts the channels of the radios to avoid RF interference (Both 802.11 and non-802.11) and develop a channel plan for the Wireless Network. Channels can be selectively assigned to be used with each RF profile. By using channels selectively, network administrators can control the co-channel interference more effectively.”). *See, e.g.*, “Meraki Auto RF: Wi-Fi Channel and Power

Management,” Cisco Meraki<sup>22</sup> (“Auto Channel dynamically adjusts the channels of the client-serving radios to avoid RF interference (both 802.11 and non-802.11) and develops a channel plan for the wireless network. Auto Channel is a good fit for most wireless networks, providing a baseline channel configuration that can then be adjusted manually if needed. This section outlines how Auto Channel operates and how to interpret channel change events. Configuration. Auto Channel is enabled by default on all Meraki access points. To ensure Auto Channel is enabled on an AP, navigate to Wireless > Configure > Radio settings in the dashboard and select a particular AP. The radio configuration for the access point will be displayed on the right-hand side of the page. The Auto Channel algorithm will be used on radios that have "Auto" selected for their channel and is performed every 15 minutes.... The dashboard offers the ability to set a default channel width, which will be factored into the Auto Channel algorithm for 5 GHz. This can be left at auto width which will adjust the width of the 5 GHz radio based on the Auto Channel algorithms discussed below. A default setting of 80 MHz width can be configured to allow for optimal wireless throughput. However, using an 80 MHz width may cause more co-channel contention. The setting can be may be reduced to 40 or 20 MHz to reduce channel overlap in high-density deployments. The default channel width can be specified on the radio settings page in the dashboard under the drop-down if using the old view page and within the RF profile settings if viewing the new dashboard page. The width may be set differently on a per-AP basis, either using the overrides by selecting an AP or by opting to use Auto... Newer Cisco Meraki APs with a dedicated scanning radio are able to use the real-time Auto Channel algorithm. Since these APs

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<sup>22</sup> Meraki Auto RF: Wi-Fi Channel and Power Management, Last Updated April 2, 2021, available at

[https://documentation.meraki.com/MR/Monitoring\\_and\\_Reporting/Location\\_Analytics/Meraki\\_Auto\\_RF%3A\\_\\_Wi-Fi\\_Channel\\_and\\_Power\\_Management](https://documentation.meraki.com/MR/Monitoring_and_Reporting/Location_Analytics/Meraki_Auto_RF%3A__Wi-Fi_Channel_and_Power_Management)

have full visibility into RF conditions on all channels, the AP and the dashboard are able to make fast channel-planning decisions in high-density RF environments. RF Metrics. Cisco Meraki APs are constantly collecting information from the RF environment; the dedicated scanning radio continually monitors on all channels for Air Marshal and RF. The table below outlines in detail the metrics that are collected by each AP and analyzed by the cloud controller for the real-time Auto Channel algorithm... Channel adjustments are made by the dashboard using information reported by the deployed APs. The dashboard will instruct an AP to change to a different channel for a number of reasons, such as when a new AP is added, the "Update Auto Channels" button is pressed, the radio channels get jammed, during the steady-state process, and during channel switch announcements. The APs in a network will use the information they have gathered from the environment and will calculate to see if there are any channels that have better performance. If an AP determines there are better channels, the AP will switch to it when the Auto Channels update every 15 minutes.”). *See, e.g.,* “Auto RF,” Cisco Meraki Blog<sup>23</sup> (“The frequency spectrum that wireless networks operate in are shared frequency spectra; this is one of the reasons that Wi-Fi networks are so polite with one another. However, there are many more potential sources of interference, such as Bluetooth and microwave ovens in the 2.4GHz spectrum or medical scanners and radar in the 5GHz spectrum. These sources of interference can have a detrimental effect on the usability of wireless networks. Meraki Auto RF is a powerful and automated RF optimization solution that ensures that Meraki Aps create the best possible environment for the clients served. Listen and Learn. Auto RF is able to do this because all Meraki APs have a dedicated security radio that also provides visual spectrum analysis. The Meraki APs also share this data with the

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<sup>23</sup> “Auto RF”, Cisco Meraki Blog, Posted by Steve Harrison, March 21, 2018, available at <https://meraki.cisco.com/blog/2018/03/auto-rf/>

Auto RF algorithm to determine the optimal channel plan and transmit power appropriately. In addition to this, Meraki network administrators can also get access to real-time channel utilization scans from the live tools section of each and every AP, as shown below”; “Auto channel is enabled by default on Meraki networks...In order to tune the transmit channel, the APs track the following three things: Usage Demand – APs within the dashboard network are monitored for their usage demand, i.e. the number of clients and amount of traffic being served by the AP. These values are mathematically combined so that each AP has a weighted value. This value is then used to ensure that the cleanest channels are utilized in the most demanding areas. Airtime Availability – Each access point listens to the contention and airtime availability, i.e. free time in the medium, for each channel and bandwidth combination. When this data is aggregated it can be used to maximize the available airtime for all APs in the network, also known as the Basic Service Set (BSS), and also minimizes contention and improves client roaming performance. All visible APs — even neighboring APs — are considered in this metric, with Meraki APs being weighted higher to optimize roaming and airtime usage distribution. As opposed to just being polite (i.e. presuming they have as high a priority to the airtime as the Meraki AP and they’re clients) with respect to neighboring networks and APs, this metric ensures that the AP and its clients also have ample airtime availability. Channel Utilization – This metric includes both 802.11 and non-802.11 (Bluetooth, microwave ovens, etc.) sources of spectrum utilization. These external sources of interference are detected and accounted for within this metric. The dashboard uses this information to tell the APs to move to a different channel if, say, a new AP is added, a channel becomes jammed, or the network administrator clicks the “Update Auto Channels” button...Channel moves can also be triggered by the “Steady State” process, which runs every 15 minutes. The Steady State process will instruct the AP to move channels if a better channel, based on the above criteria exists.

However, the Steady State process is aware when a channel is being used for point-to-point communications and it will not change the channels of APs acting as a gateway AP...”).

70. Each '939 Accused Product is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal, wherein the signal transmission/reception coordination logic restrains at least one other access point of the plurality of access points from transmitting the other signal on a first channel responsive to the ascertaining that the access point of the plurality of access points is receiving the signal on a second different channel. For example, as with each '939 Accused Product, the Cisco 9120AX Series Access Point with embedded wireless controller is an apparatus comprising a signal transmission/reception coordination logic that is capable of ascertaining, by monitoring the plurality of access points for received signals, that a first access point of the plurality of access points is receiving a first signal and that is adapted to restrain at least two other access points of the plurality of access points from transmitting signal responsive to the ascertaining that the first access point is receiving the first signal, wherein the signal transmission/reception coordination logic restrains at least one other access point of the plurality of access points from transmitting the other signal on a first channel responsive to the ascertaining that the access point of the plurality of access points is receiving the signal on a second different channel. *See, e.g.*, Cisco Catalyst 9120 Series Wi-Fi 6 Data Sheet (“Going beyond the Wi-Fi 6 (802.11ax) standard, the 9120AX Series provides integrated security, resiliency, and operational flexibility as well as increased network intelligence”; “Cisco RF ASIC is a fully

integrated Software-Defined Radio (SDR) that can perform advanced RF spectrum analysis and delivers features like Cisco CleanAir®, Wireless Intrusion Prevention System (wIPS), Fast Locate\*, and DFS Detection”; “Supporting four spatial streams, Multiuser Multiple Input Multiple Output (MU-MIMO) enables access points to split spatial streams between client devices, to maximize throughput.”; “Uplink/Downlink OFDMA”; “Flexible Radio Assignment”; “Dual 5-GHz radio support”; “Smart antenna connector”; “Cisco Embedded Wireless Controller”; “The 9120AX Series Wi-Fi 6 access points is available with a built-in controller. The Cisco Embedded Wireless Controller on Catalyst 9100 Access Points provides an easy-to-deploy and manage option that does not require a physical appliance. The control resides on the access point, so there is no added footprint or complexity. And, because it uses Cisco Catalyst 9800 Series Wireless Controller code, it’s easy to migrate your network as your needs grow.”). *See, e.g.,* Cisco Clean Air Technology<sup>24</sup> (“Four of every five business report problems with radio frequency interference (RFI). Whether your network conforms to the Wi-Fi 5 or Wi-Fi 6 standard, Cisco CleanAir Technology identifies the source, location, and scope of RFI and can proactively guard against it.”). *See, e.g.,* Cisco CleanAir Technology At-a-Glance<sup>25</sup> (“Self-Healing and Self-Optimizing Wireless: With Cisco CleanAir technology, if an interference source is strong enough to completely jam a Wi-Fi channel, the system will change channels within seconds to avoid the interference, resuming client activity on another channel outside of the affected area. The system remembers intermittent interference from persistent sources such as a microwave ovens, wireless bridges, or wireless video cameras. Through tight integration with Cisco radio resource management technology, the CleanAir

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<sup>24</sup> Cisco CleanAir Technology, available at <https://www.cisco.com/c/en/us/solutions/enterprise-networks/cleanair-technology/index.html>

<sup>25</sup> Cisco CleanAir Technology At-a-Glance, available at [https://www.cisco.com/c/dam/en/us/solutions/collateral/enterprise-networks/cleanair-technology/aag\\_c22-594304.pdf](https://www.cisco.com/c/dam/en/us/solutions/collateral/enterprise-networks/cleanair-technology/aag_c22-594304.pdf)

solution indicates the channels where these devices operate so that system administrators can optimize performance and minimize future disruption.”). *See, e.g.*, “Interference Detection and Mitigation with Cisco CleanAir,”<sup>26</sup> Cisco Blogs (“Cisco CleanAir solution not only detects the source of interference, but also automatically changes the channel on which the WiFi network is operating to a channel clear of interference. This is done with a dedicated best-in-class spectrum analysis chip that resides within Cisco CleanAir Access Points. The built-in spectrum analysis chip and software does all the classification of devices. What is sent from the AP to the wireless controller and Prime Infrastructure (PI) management system are interferer records and channel air quality metrics. AirQuality is a metric that indicates how good a channel is for WiFi communication. The Air Quality Index is calculated right there in the AP and is measured on a scale from 1 – 100, where 100 is excellent and 1 is poor. In essence, AirQuality is a measurement of non-wifi and adjacent channel interference. Every device that is classified is assigned a severity, which is measured on a scale from 0 – 100. Severity of 0 means device is not severe and a value of 100 means device is extremely severe and can severely impact wireless communication. Severity accounts for the type of device, Duty Cycle and Power as measured at the radio. The AirQuality Index is derived from the severities of all interfering devices affecting the radio/serving channel. Interferers are classified and sent to the controller from the access points. Interferers don’t have digital signatures, so if more than one access points detects a single interferer, then each access point which hears it will report it as a separate interferer. The WLC will identify them as unique interferers despite being the same interferer, so there is a potential for the system to be flooded with duplicate interferer reports. To solve this problem, the controller has some merging

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<sup>26</sup> “Interference Detection and Mitigation with Cisco CleanAir,” Amit Hakoo, Cisco Blogs, available at <https://blogs.cisco.com/networking/interference-detection-and-mitigation-with-cisco-cleanair>

and clustering algorithms in place so that only one Interferer is reported to MSE or PI. The controller forwards the interferer information to the Mobility Services Engine, which has interferer location algorithms in place to locate the interferer on a map. Interferer information like Duty Cycle, affected channels and severity is presented whenever user hovers over any of the interferers on the map. **Figure 2.** An interferer ZOI (Zone Of Impact) metric is displayed as a circle where radius indicates the impact zone and opacity is the severity of the Interferer. If multiple interferers are close in proximity to one another, then their zones can overlap, thus increasing the opacity, which could indicate that the interference is severe enough in that zone to affect WiFi communication. **Figure 3.** With Cisco's CleanAir solution, you can not only detect which interferer is disrupting your WiFi, but also which channels it is affecting and where it is located. The same can be done for multiple sources of interference simultaneously. All this can be done with great accuracy which differentiates CleanAir solution with what the competition offers. Cisco Radio Resource Management consumes this information and helps in mitigating Interference issues by calculating alternate channel and power plans. There are a couple of mitigation approaches that RRM Module can use. One is Energy Detect RRM which works off the AirQuality metric on a per Access Point basis and the other is Persistent Device Avoidance where It does some predictive analysis so that access points stay away from channels where persistent interferers like microwave ovens are detected. Interference detection and mitigation is the complete solution that Cisco CleanAir provides. What is important to remember is that spectrum intelligence information is directly reported to RRM as an input and highly integrated into the resulting RRM solutions.”)

71. Defendant also has been and is now knowingly and intentionally inducing infringement of at least claim 1 of the '939 Patent in violation of 35 U.S.C. § 271(b). Through at

least the filing and service of this Complaint, Defendant has had knowledge of the '939 Patent and the infringing nature of the '939 Accused Products.

72. Despite this knowledge of the '939 Patent, Defendants continue to actively encourage and instruct its customers and end users (for example, through user manuals and online instruction materials on its website) to use the '939 Accused Products in ways that directly infringe the '939 Patent. For example, Defendants' websites provided, and continues to provide, instructions for using the Accused Products on wireless communications systems, to utilize their 802.11ax beamforming and/or MU-MIMO functionalities and to utilize their CleanAir functionalities and/or Auto RF functionalities. Defendants do so knowing and intending that its customers and end users will commit these infringing acts. Defendant also continue to make, use, offer for sale, sell, and/or import the '939 Accused Products, despite its knowledge of the '939 Patent, thereby specifically intending for and inducing its customers to infringe the '939 Patent through the customers' normal and customary use of the '939 Accused Products. Defendants also knew or were willfully blind that its actions would induce direct infringement by others and intended that its actions would induce direct infringement by others. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of Vivato's '939 Patent in the United States because Defendants had knowledge of the '939 Patent and actively induced others (*e.g.*, its customers) to directly infringe the '939 Patent.

73. Defendants also contributorily infringe by making, using, selling, offering to sell, and/or importing the '939 Accused Products, knowing they constitute a material part of the invention, are especially made or adapted for use in infringing, and that they are not staple articles of commerce capable of substantial non-infringing use.

74. By making, using, offering for sale, selling and/or importing into the United States the '939 Accused Products, Defendants have injured Vivato and is liable for infringement of the '939 Patent pursuant to 35 U.S.C. § 271.

75. Defendant also infringes numerous additional claims of the '939 Patent, including Claims 2 – 35, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 1.

76. Vivato's '939 Patent is valid and enforceable.

77. Vivato has complied with 35 U.S.C. § 287 to the extent it applies (*i.e.*, non-method claims) and it does not preclude the recovery of pre-suit damages at least because there are no unmarked patented articles subject to a duty to mark.

78. As a result of Defendant's infringement of the '939 Patent, Defendant has damaged Vivato, and Vivato is entitled to monetary damages in an amount to be determined at trial that is adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

79. Defendant's infringing activities have injured and will continue to injure Vivato, unless and until this Court enters an injunction prohibiting further infringement of the '939 Patent, and, specifically, enjoining further manufacture, use, sale, importation, and/or offers for sale that come within the scope of the patent claims.

#### **WILLFUL INFRINGEMENT**

80. Defendant had knowledge of Vivato's '728 Patent by at least the date of the filing and service of the Complaints for Patent Infringement dated April 19, 2017 and May 3, 2017 in the United States District Court for the Central District of California.

81. Despite Defendant's knowledge of Vivato's '728 Patent and its patent portfolio, Defendant infringed and continues to infringe the '728 Patent with full and complete knowledge of the patents' applicability to Defendant's MU-MIMO Wi-Fi 6 access point and router products without taking a license and without a good faith belief that the '728 Patent are invalid and not infringed. Defendant's infringement occurred, and continues to occur, with knowledge of infringement and objective recklessness.

82. Defendant sold, and continues to sell, its Accused Products (*e.g.*, Wi-Fi 6 / IEEE 802.11ax Access Points such as the Cisco 9117 or 9120 Series) to customers despite its knowledge of Vivato's Asserted Patents, such as on Cisco.com or [cisco.com/go/smartaccounts](https://www.cisco.com/go/smartaccounts). Defendant also manufactured and imported into the United States, and continues to do so, the Accused Products for sale and distribution to its customers, despite its knowledge of Vivato's Asserted Patents, including without limitation the '728 Patent.

83. Defendant's infringement of Vivato's '728 Patent is egregious because despite its knowledge of the '728 Patent, Defendant deliberately and flagrantly copied the invention claimed in the '728 Patent and implemented that patented invention in its Accused Products. Further, despite Defendant's knowledge of the '728 Patent, Defendant sold, offered for sale, manufactured, and imported, the Accused Products—and continues to do so—without investigating the scope of the '728 Patent and without forming a good-faith belief that its Accused Products do not infringe or that the '728 Patent is invalid. Defendant has not taken any steps to remedy its infringement of the '728 Patent (*e.g.*, by removing the Accused Products from its sales channels). Instead, Defendant continues to sell its Accused Products to customers, such as its continued sale of its Cisco 9117 Series. Defendant's behavior is egregious because it engaged, and continues to engage, in misconduct beyond that of typical infringement. For example, in a typical infringement, an

infringer would investigate the scope of the asserted patents and develop a good-faith belief that it does not infringe the asserted patents or that the asserted patents are invalid before selling (and continuing to sell) its accused products. An infringer would also remove its accused products from its sales channels and discontinue further sales.

84. Thus, Defendant's infringement of the '728 Patent is willful, deliberate, and flagrant, entitling Vivato to increased damages under 35 U.S.C. § 284 and to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

### **PRAYER FOR RELIEF**

WHEREFORE, Vivato respectfully requests that this Court enter:

- a. A judgment in favor of Vivato that Defendant has infringed, either literally and/or under the doctrine of equivalents, the '728 Patent, the '376 Patent, the '939 patent;
- b. A permanent injunction prohibiting Defendant from further acts of infringement of the '728 Patent, the '376 Patent, the '939 patent;
- c. A judgment and order requiring Defendant to pay Vivato its damages, costs, expenses, and pre-judgment and post-judgment interest for Defendant's infringement of the '728 Patent, the '376 Patent, the '939 patent;
- d. A judgment and order requiring Defendant to provide an accounting and to pay supplemental damages to Vivato, including without limitation, pre-judgment and post-judgment interest and an award of an ongoing royalty for Defendant's post-judgment infringement in an amount according to proof;
- e. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Vivato its reasonable attorneys' fees and costs against Defendant, and enhanced damages pursuant to 35 U.S.C. § 284; and

f. Any and all other relief as the Court may deem appropriate and just under the circumstances.

**DEMAND FOR JURY TRIAL**

Vivato, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

Dated: June 16, 2021

Respectfully submitted,

/s/ Reza Mirzaie

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d/b/a Vivato Technologies, Inc.***